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Vol. xv MAY, 1910 No. 5

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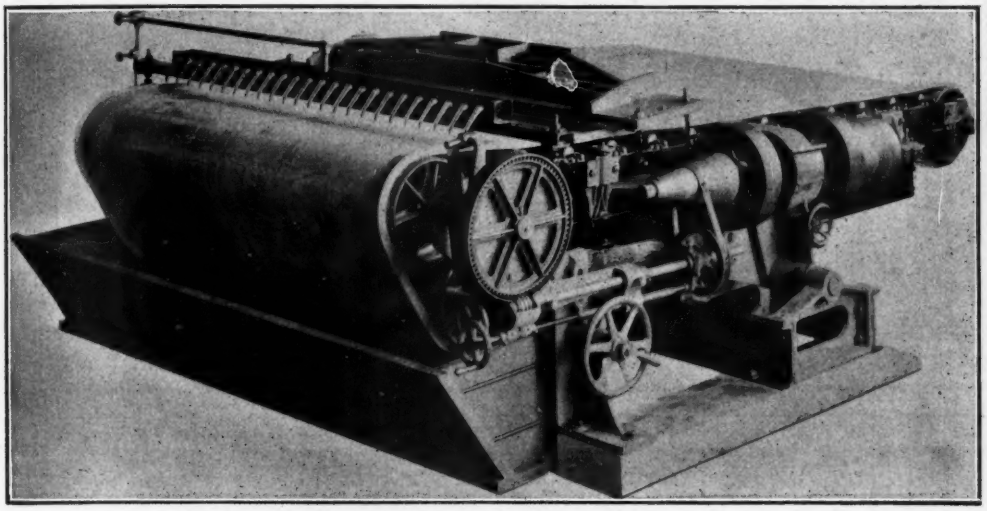

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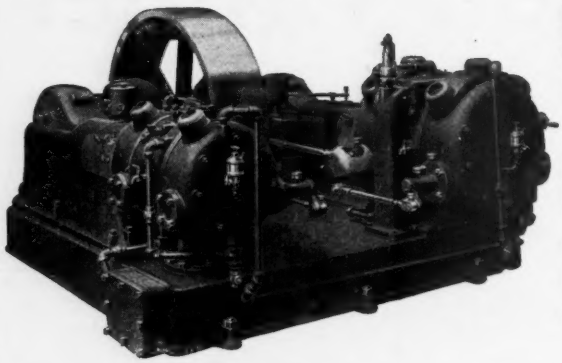

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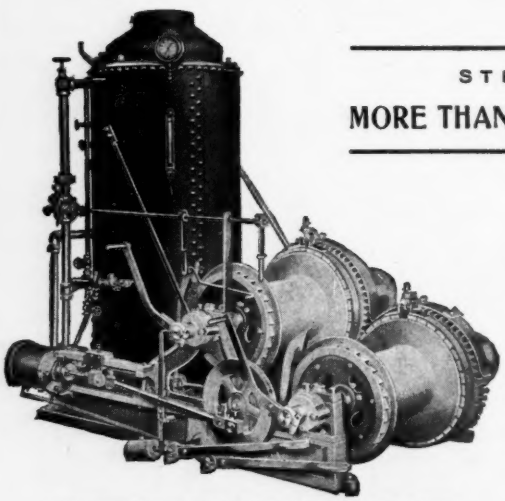

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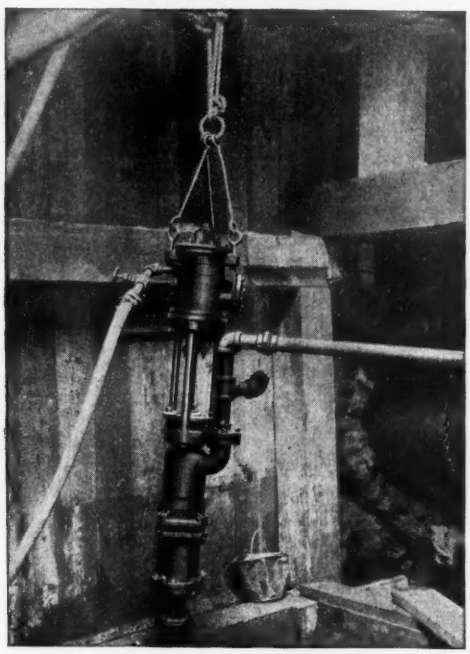

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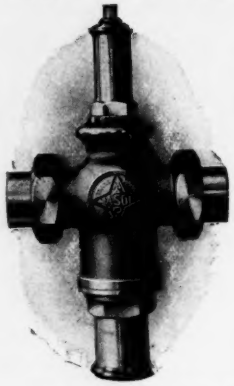

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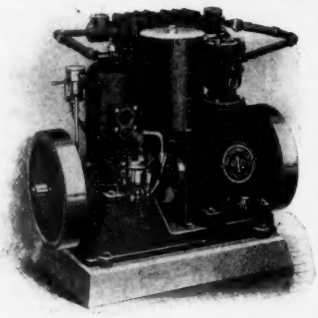

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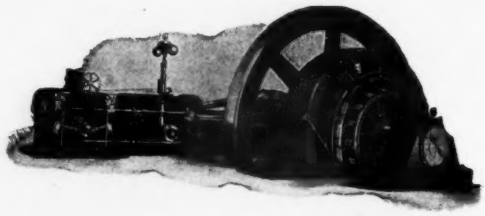

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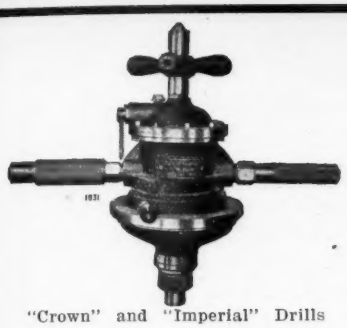

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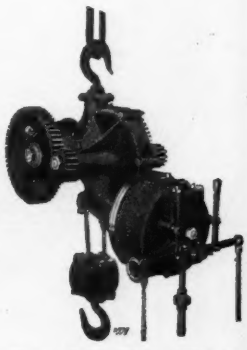

"Imperial" Motor Hoists

INDEX TO ADVERTISERS.

American Metal Hose Co. 13
Atlantic Refining Co. 2
Betton, J. M. 14
Black Diamond 12
Boiler Maker .....
Borne, Scrymser Co. 18
Burnham Williams & Co. 11
Bury Compressor Co. ..... Back Cover
Cameron Steam Pump Works, A. S. 5
Chicago Pneumatic Tool Co. ..... Front and Back Covers
Clement Restein Co 9
Continental oil Co. 2
Cooper Co., C. & G. 6
Curtis & Co. Mfg Co. 15
Dixon Crucible Co., Jos. 15
Engineering Contracting .....
Engineering Digest .....
Engineering Magazine .....
Engineering News .....
Fiske Bros. Refining Co. 2
Galigher Machinery Co. 3
Gardner Governor Co. 6
Goodrich Co., The B. F. ..... Front Cover
Harris Air Pump Co 12
Harrison Supply Co. 16
Ingersoll-Rand Co. ..... 7 and 15
Januey. Steinmetz & Co. 14
Jarecki Mfg. Co. 13
Lidgerwood Mfg. Co. 4
McKiernan Drill Co. 15
McNab & Harlin Mfg. Co. 12
Mason Regulator Co. 6
Metric Metal Works 19
Mines & Minerals .....
Mining & Scientific Press 18
Oldham & Son Co., Geo. 19
Pangborn Company, Thomas W. 9
Porter Co., H. K. 11
Powell Co., Wm. 14
Proske, T. H. 10
Quarry .....
Republic Rubber Co. 10
Sprague Electric Co. 13
St. John, G. C. 19
Standard Oil Co. 2
Stearns-Roger Mfg. Co. 8
Sullivan Machinery Co. 4
Vacuum Oil Co. 2
Westinghouse Air Brake Co. ..... Back Cover

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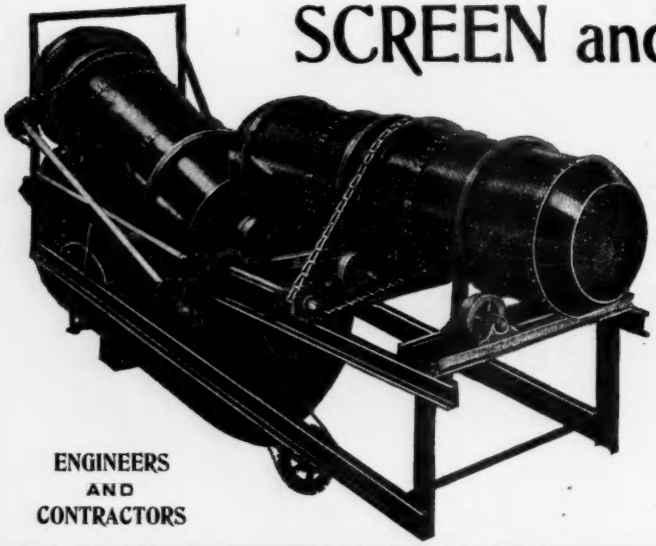

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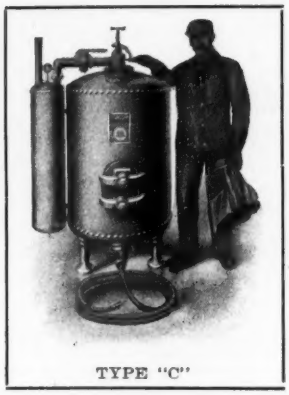

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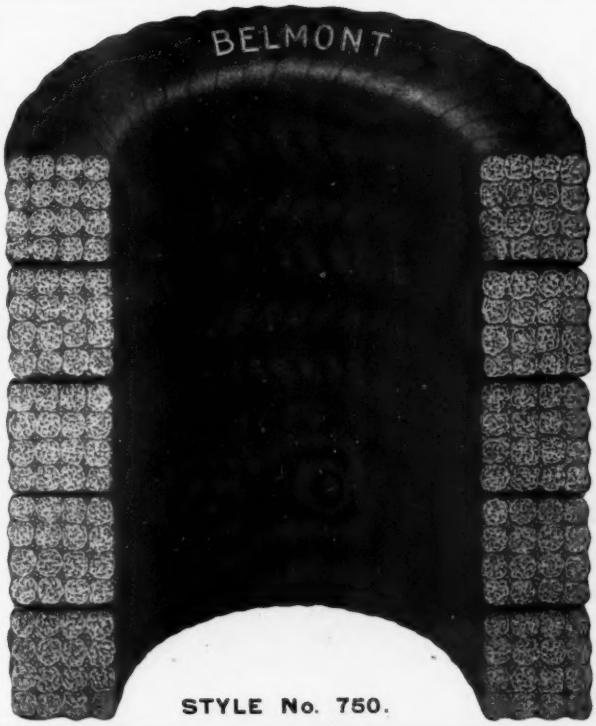

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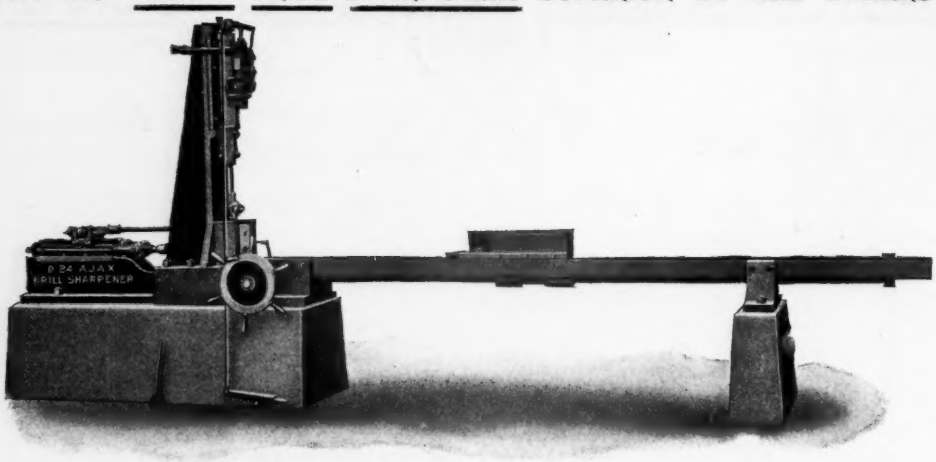

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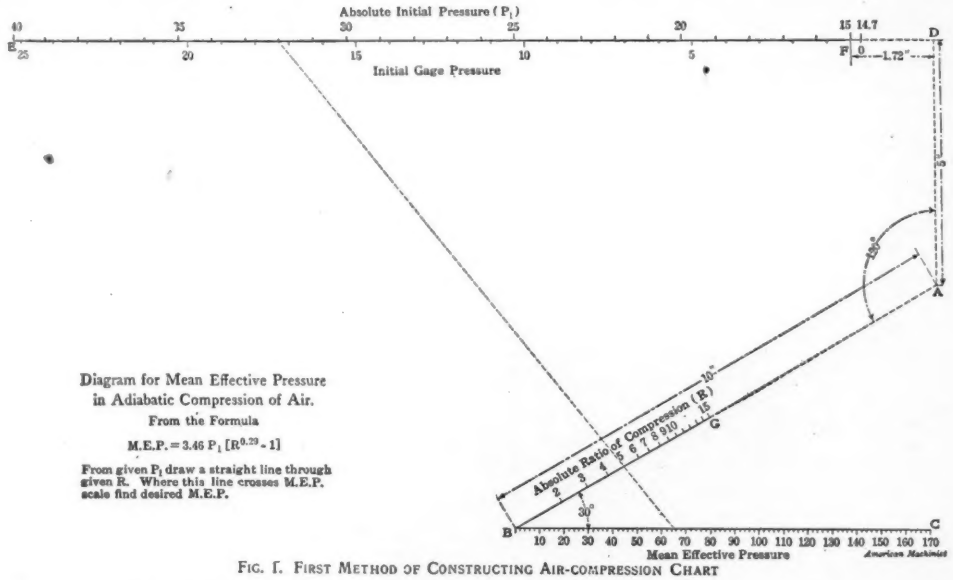

Absolute Initial Pressure (P_1)
40 35 30 25 20 15 14.7
E 25 20 15 10 5 F 0 1.72"
D
Initial Gage Pressure
A
Diagram for Mean Effective Pressure in Adiabatic Compression of Air.
From the Formula
M.E.P. = 3.46 P_1 [$R^{0.29}$ - 1]
From given P_1 draw a straight line through given R. Where this line crosses M.E.P. scale find desired M.E.P.
Absolute Ratio of Compression (R)
2 3 4 5 6 7 8 9 10 15
G
30°
B
C
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170
Mean Effective Pressure
American Machinist

FIG. 1. FIRST METHOD OF CONSTRUCTING AIR-COMPRESSION CHART

MEAN EFFECTIVE PRESSURES IN AIR COMPRESSION

BY H. L. SEWARD.

[The following article is reproduced without change by the kind permission of the editor of the *American Machinist.* It is copyrighted (1910) by the Hill Publishing Company.—ED. C. A. M.].

Each of the accompanying diagrams consists of three straight-line scales so placed that if a straight-edge be laid across them, the readings of the scales where the straight-edge crosses them, will satisfy the formula:

$$M.E.P. = 3.46\, P_1\, (R^{0.29} - 1)$$

When any two of the three variables (M.E.P.), P_1 or R are given, the third may be immediately determined by laying a straight-edge over (or drawing a straight line through) the two given quantities and noting the reading under the straight-edge on the third scale. For example, if P_1 is given as 32 pounds per square inch absolute, and R as 5, then in Fig. 1, a straight line from 32 on scale P_1 through 5 on scale R shows that the M.E.P. must be 65.8. Or if P_1 is 20 and R is 7, Fig. 2, shows that the M.E.P. must be 52.5.

For the benefit of those who might wish to construct these diagrams on a little larger scale, the following method of construction is given:

Method 1. (Fig. 1).

At a point A, draw a vertical line $A\ D$, 5

inches long and draw $A\ B$ so that the angle $D\ A\ B = 120$ degrees. Make $A\ B$ ten inches long. At D and B draw horizontal lines $D\ E$ and $B\ C$, respectively. Upon $B\ C$ lay off a scale of 20 to the inch for the scale of M.E.P. From D measure $D\ F = 1.72$ inches as shown, thus locating the point 15 on the scale for P_1. From F continue the scale P_1 as far as desired, making the distance from one graduation to the next equal to 0.692 inch. If desired each space may be sub-divided into 10 equal parts so that the scale reads to hundredths.

The points on the scale for R are located

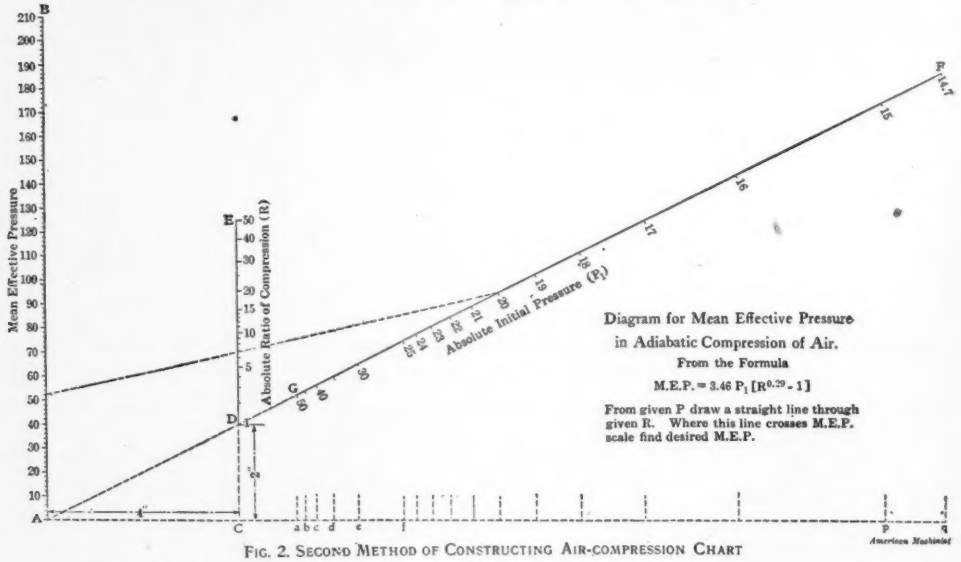

Mean Effective Pressure
Absolute Ratio of Compression (R)
Absolute Initial Pressure (P1)
Diagram for Mean Effective Pressure
in Adiabatic Compression of Air.
From the Formula
M.E.P. = 3.46 P1 [R0.29 - 1]
From given P draw a straight line through given R. Where this line crosses M.E.P. scale find desired M.E.P.
American Machinist

FIG. 2. SECOND METHOD OF CONSTRUCTING AIR-COMPRESSION CHART

by computing the distance in inches of each point from A by means of the formula:

$$x = \frac{0.5\,(R^{0.29} - 1) - 2}{0.5\,(R^{0.29} - 1) + 2} \times 10$$

where x is the distance of any point R from A. For example, to locate the point 8 on scale R we have:

$$x_8 = \frac{0.5\,(8^{0.29} - 1) - 2}{0.5\,(8^{0.29} - 1) + 2} \times 10 = 6.57\ \textit{inches}.$$

The computation from this formula is not as difficult as it might seem at first sight, if carried on systematically. In the following table the values of R in the first column were written down one under another. Each one was raised to the 0.29th power by logarithms and results written in the second column. Then 1 was subtracted from each number in the second column to obtain the values in the third column. Values in the third column divided by 2 gave the fourth column of figures. Then each of the numbers in the fourth column was subtracted from 2 which gave the values in the fifth column. Values in the fourth column added to 2 gave the numbers in the sixth column. The quotient of numbers in the fifth column divided by numbers in the sixth, gave the last column. This last column, multiplied by 10 gives the desired values of x.

All three scales may be continued in length up to any desired limit.

Method 2. (Fig. 2).

Draw $B\ A$ and Aq at right angles. On $A\ B$ lay out a scale for M.E.P., 20 to the inch. Draw $C\ E$ parallel to $A\ B$ and 4 inches away from it. Through A draw $A\ F$ with a slope of 1:2 that is, $A\ C$ will be 4 inches and $C\ D$, 2 inches. The scale for R on $C\ E$ is laid out with values of $R^{0.29}$ multiplied by two inches. These values may be taken from column 2 in table above. For example, the distance from C to a point 9 on scale R is $2 \times R^{0.29} = 2 \times 1.891 = 3.782$ inches.

To plot the points comprising the scale for P_1 it is easier to locate the points $a, b, c, d \ldots\ldots q$ on Cq directly underneath. These are located from the formula:

$$x = \frac{-8}{-0.173\,P_1 + 2}$$

R	$R^{0.29}$	$R^{0.29}-1$	$0.5\,(R^{0.29}-1)$	$\frac{A}{0.5\,(R^{0.29}-1)-2}$	$\frac{B}{0.5\,(L^{0.29}-1)+2}$	$\frac{A/B}{\frac{r}{10}}$
1	1.000	0.000	0.000	—2.000	2.000	1.000
2	1.223	0.223	0.112	—1.888	2.112	0.889
3	1.375	0.375	0.188	—1.812	2.188	0.829
4	1.495	0.495	0.248	—1.752	2.248	0.780
5	1.595	0.595	0.298	—1.502	2.298	0.742
6	1.682	0.682	0.341	—1.659	2.341	0.708
7	1.758	0.758	0.379	—1.621	2.379	0.682
8	1.828	0.828	0.414	—1.586	2.414	0.757
9	1.891	0.891	0.446	—1.554	2.446	0.636
10	1.950	0.950	0.475	—1.525	2.475	0.617
11	2.004	1.004	0.502	—1.498	2.502	0.598
12	2.058	1.058	0.529	—1.471	2.529	0.583
13	2.104	1.104	0.552	—1.448	2.552	0.568
14	2.150	1.50	0.575	—1.425	2.575	0.553
15	2.193	1.193	0.597	—1.403	2.597	0.539

For example, to obtain the point 30, we have:

$$Ce = \frac{-8}{-0.173 \times 30 + 2} = 2.51 \text{ inches},$$

Locate point e 2.51 inches from C and erect a perpendicular to $C\ q$ at e. Where this perpendicular crosses $A\ F$ gives point 30 on scale P_1.

The two diagrams are two different arrangements of plots for accomplishing the same end. Fig. 1 is probably the more accurate of the two, due to the sharper intersections, but Fig. 2 would be more convenient in cases where higher values of P_1 are to be used.

AERIAL PROPERTY RIGHTS

The advent of the airship suggests some questions as to the ownership of the air and the rights of aerial navigation. The owner of land anywhere is assumed to own the air above it, and one who traverses the air must be technically guilty of trespass, in which there would seemed to be sometime some possibility of misunderstanding, and the question is what should be done about it, At a meeting of the Aero Club of America in New York, Mr. Littleton Fox suggested that the most effetcive solution would be by the assertion of the right of eminent domain. The State, he said, should condemn the air as a highway and take title to it, subject to the right of the land owner to build as high as he likes, or to make any other private use of the air above his land. Payment to each owner of whatever he should be able to prove to be the value of the air above his land should be provided. A cent apiece would seem to be ample compensation in most cases.

EMERGENT TREATMENT FOR LEAKY PISTONS

A writer in a recent issue of *Machinery* describes a makeshift treatment for reducing the leakage of gas engine pistons which in some cases might be available for air compressor pistons, and those of air motors. The method is, briefly, as follows: Take out the piston and take off the rings. Clean the piston rings and grooves thoroughly. Get a piece of soft abestoes rope and before putting the rings back into place, wind some of the rope in the bottom of the ring grooves in the piston. Then soak the asbestos thoroughly with gas engine cylinder oil, and put the ring back in the grooves. Put in enough of the asbestos rope so that the rings will have to squeeze it down fairly tight when the piston is pushed into the cylinder. This method may not be considered as a very mechanical job, but an old leaky piston when so treated will, after running a few minutes, be very tight, and may run for months before the operation needs to be repeated.

A BATH TUB FOR MULES

In the Henry colliery of the Lehigh Valley Coal Company the mine foreman, Mr. A. J. O'Malley, has introduced a bath tub for the mules in the mine, and it is pronounced a great success. When a mule is taken down into the mine he may be said to "leave all hope behind," as he seldom ever again sees the light of day, and this bath tub becomes an important feature in the lives of those who are privileged to enjoy it.

The tub is a concrete affair, some 40 ft. long and a little over 4 ft deep. It is built inside the mine just at the entrance to the mule sta-

ble. The long eared fellows are tired enough at the end of the day's work, and when they strike the bath they rush into it with evident glee, crowding each other for the deepest part of the tub. Directly over the water runs a perforated pipe, and when the shower bath is turned on the mules fairly neigh with pleasure at the exhilarating fun they seem to find in the invigorating treat. The speed with which mules will travel to the stable when the day's work is over is proverbial; yet with all their desire to reach their stalls and get the second meal of the day, they have to be driven by force out of the bath and into the barn.

Foreman O'Malley has received many congratulations upon the success of his scheme. There can be no doubt that he has evolved a plan which prolongs the vigor and vitality of the mine mule, a valuable asset for the company, but he has also provided a substantial means of pleasure for the beasts who have so little to break the monotony of their lives.

COMPRESSED AIR PIPE AND RECEIVER EXPLOSIONS IN THE TRANSVAAL

The following is from the Annual Report of the Government Mining Engineer for the year 1908-9.

The accident that occurred at the Langlaagte Deep, Ltd., on March 25, 1909, was the most serious of four similar occurrences in which explosions or firing took place in the discharge pipes or receivers of air compressors. At the Crown Mines, Ltd., there was a more violent explosion, but, owing to the great damage to the pipe line, which was absolutely wrecked in several places, no dangerous gas was delivered at the working places in the mine.

In the former accident, however, the resultant fumes from the explosion were discharged through a compressed air main into the mine and caused the death of ten persons and injuries to three others.

At the Roodepoort United Main Reef, Ltd., and the Main Reef, Ltd., there were cases of firing with no violent explosion and no mere serious damage to plant than the bursting of a few of the intercooler tubes, but in each case persons underground were gassed and there was one fatality. In these two instances the low-pressure side of the compressor appeared to be the seat of the trouble, but at the Langlaagte Deep and the Crown Mines the explosion occurred at the high-pressure valve chest or in the receiver.

All these accidents were followed by complete investigation into the attendant circumstances, but in no case could the actual cause be definitely assigned. There is, however, no doubt that the explosive mixture consists of air and the gases distilled from the lubricant deposits. It is possible that these volatile constituents of the oil may also carry very fine dust, which assists in lowering the ignition temperature of the mixture. Without allowing the possibility of sparks being created or very high local temperatures being caused by friction within the cylinders of the compressor, one has to regard the failure, partial or complete, of the water supply to jackets or intercooler as the probable reason for a rise in temperature sufficiently high to ignite the hydrocarbon deposit or the explosive gases distilled from this accumulation.

It may be mentioned that many tests have been made of the lubricating oils used in the compressor cylinders and these have invariably been found to have high flash points, i. e., above 600 degrees F. The ignition temperatures will, of course, be much higher than these flash points. The hydrocarbon deposit usually found in air receivers and pipes will burn and can be ignited with an ordinary match. In one case it was found that the carbonized matter taken from a compressor valve chest, when mixed with the lubricating oil, lowered the flash point of the latter. The substance seemed to cause a catalytic decomposition of the oil carbon and a more combustible gas. The analysis of this substance showed 30 per cent. of mineral ash, mostly iron oxide, but with marked quantities of copper and zinc and a little potash and soda. This suggests the corrosion of iron and brass by fatty acids—probably soft soap had been occasionally used as a lubricant.

While pursuing inquiries into the causes of firing and explosions in compressors, the following additions to the Mines and Works Regulations are proposed to endeavor to prevent this class of accident:

(2) All compressed air receivers and their connections to air cylinders shall be kept clean and free from carbonized oil or other material liable to ignition, and shall be opened and examined in this respect, by the resident me-

chanical engineer appointed under Regulation No. ..... or other duly authorized and competent person at intervals not exceeding one month. A written record of each such inspection signed by the person making it, who shall be held responsible for compliance with this regulation, shall be in the user's possession and open to inspection by the Inspector of Machinery.

(3) Thermometers or pyrometers, the indications of which can be clearly read, shall be fitted close to the outlet valves on the discharge pipes from the cylinders of air compressors. The highest temperature allowed shall be indicated by a red mark on the scale, and the engine-driver in charge shall be responsible that this temperature is not exceeded.

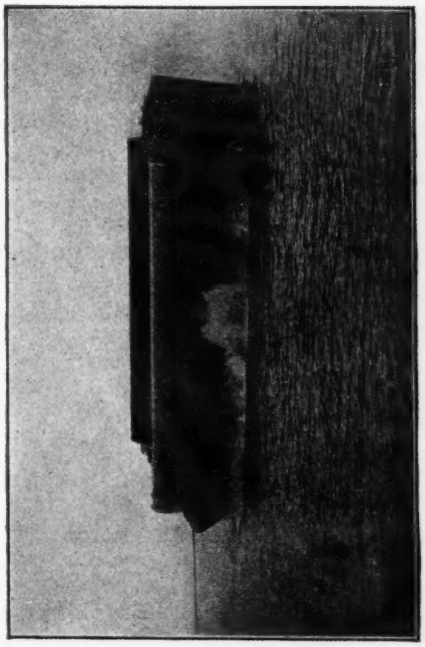
AIR OPERATED SELF-DUMPING SCOW

The half tones and cuts, which we here reproduce from *Engineering News,* give us a clear idea of the construction and operation of an ingenious self-dumping scow or barge which has been successfully employed in Sweden, and which seems destined to make for itself a wide field of usefulness. The description which follows is by the inventor, Mr. A. F. Wiking, of Stockholm, Sweden.

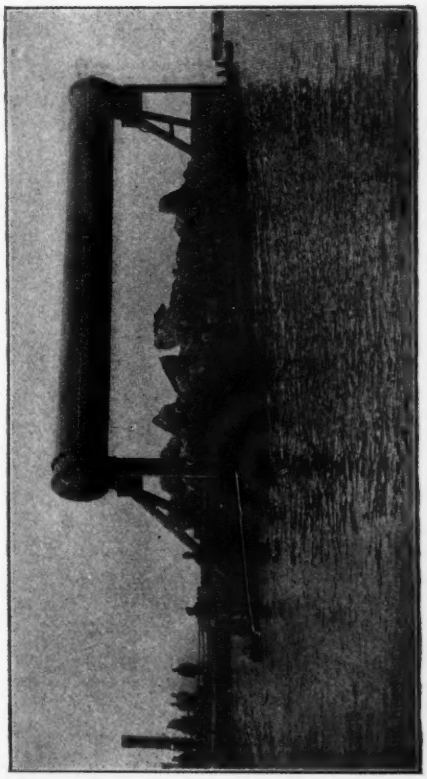
The problem of dumping stone and dirt into the water is particularly of interest in Stockholm, where blasting goes on all the time in the work on extensions of the harbor and streets. A good many designs for automatic dumping barges have been suggested, but none has come to a trial except the one hereby presented. Of course the common hopper barges with doors in the bottom have been largely used.

The accompanying figures show a new type of barge designed by the writer. The mode of dumping is new, so far as the writer is aware, and has had its natural development on account of the large quantities of rocks which must be dumped in the waters about Stockholm. The common hopper barges with flaps in the bottom have not proved suitable for this particular work. The city authorities, therefore, up to this time, have exclusively used barges with ridged decks and flaps along the side. The dumping has been by hand power, though helped by inclination of decks.

When the design shown in the accompanying figures was fabricated in steel and tested, it



SCOW DUMPED.



SCOW LOADED.

FIG. 1.

worked so successfuly that no alterations whatever were necessary.

The barge has taken on a load of 200 to 220 tons and dumped it without any hitch whatever, and is doing so continually. It takes twice as much load as the ridge-deck barges, costs only 3-5 as much as two such barges and saves the wages of 6 to 8 laborers. Of course, if the load was gravel or material suitable for the common hopper barges, the saving in working would not be as large as above. In such a case, however, one has to reckon with a much larger initial cost for hopper barges and with heavier outlay for maintenance. In this new barge the hull is not exposed to the attack of the cargo, which is delivered on a flat deck of ample dimensions. The deck is protected by a timber flooring which is easily and cheaply replaced.

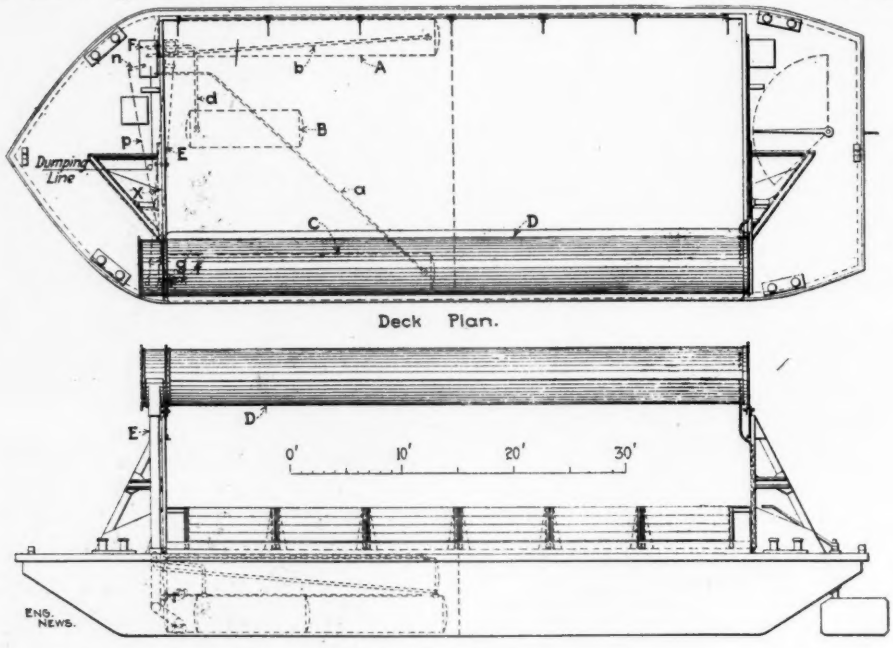
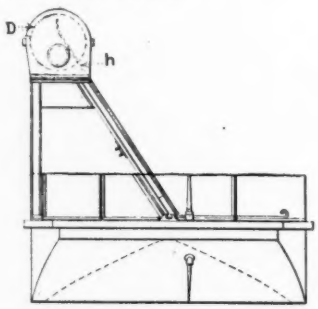


FIG. 2.

Fig. 2 shows the general features and lines of the design. Fig. 3 is a cross-section of the hull. The operation is as follows: The tank "A" is filled with water (about 6 tons, for a deck of 200 tons, in the actual design shown). The tank "B" contains compressed air at about seven atmospheres pressure. The tank "C" is at first empty but open to the air through the pipe "a." The tank "A" is in open communication with the upper cylinder "D" by the pipe "E." The tank "A" is also connected by an air pipe "b" to a valve box "F." The compressed-air tank "B" is connected to the valve box by the air pipe "d." While the tank "C" is always open to the free air through the pipe "a," yet it connects by the pipe "f" and valve "g" to the main pipe "E" going from the water tank "A" to the elevated tank "D." The tank "D," it will be seen, is always in open communication with the water tank "A" and with the atmosphere by the pipe "h."



The valve box contains a slide-valve mechanism which may be given four successive arrangements by successive pulls on a small line

running from the barge to the towing vessel. These operations of the valve mechanism change the weight distribution on the barge so that it is dumped and returned to normal position merely by pulls on the dumping line.

The load is placed on deck, which has bulwarks on three sides. The fourth side (that one below the cylinder "D") must have only a low ridge "k"—Fig. 3, or doors to be opened by the pressure from the load on the inclined deck. For loads of rocks even the ridge is not wanted—a smooth deck is needed.

After the barge is loaded and towed to the dumping place, the operating line is carried over to the towing vessel. By the first pull on the cord, compressed air is admitted to the tank "A" and the water is forced up into the cylinder "D," so that the barge losses its equilibrium. It then tips until the rocks slide off. A second pull on the cord shuts the supply of compressed air off from the tank "A" and connects the latter to the atmosphere.

If the load slides off before the upper tank "D" reaches the water, then at the second pull on the operating cord the water drains from "D" back to the tank "A." If the tilting has been complete so that "A" is not lower than "D," then by a third pull on the cord the water in "D" is drained off to the intermediate tank "C," which is always lower than "D." To effect this the valve-box mechanism throws into gear the lever "m," shaft "r," lever "n," connecting rod "p" and the valve "g." The barge rises and soon is upright and the water in "C" (with any not drained from "D") flows back into the tank "A." A fourth pull on the cord restores the valve mechanism to its original position, as before the dumping. The pipe "X" is for sounding the liquid in tank "A." As none of this water ballast is lost in opening, glycerine is mixed with it to prevent freezing in cold weather.

Compressed air is fed to the tank "B" by a hose connection and shut-off valve at the valve box. About 2 cu. m. (71. cu. ft.) of compressed air are necessary for a single dumping The cost is small. Here it costs some 50 öre, or about 12 cts., if obtained from a shop installation for pneumatic tools. A small compressor, worked by an oil engine may be placed on one tug and used for all the barges of a fleet.

The illustration on page 5647 shows a barge

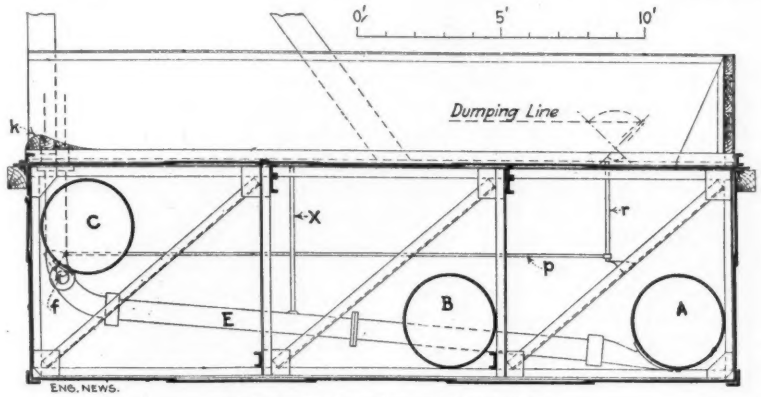


FIG. 3. CROSS SECTION OF HULL.

delivered to the city of Stockholm, where it is in daily service.

In comparing this barge with the common hopper barges with false bottom it appears that it is cheaper in first cost and will be cheaper in maintenance, that it accommodates rocks of practically any size and weight within its total capacity, that it is a first class craft for any harbor transport.

A hospital for the workers on the Wallkill pressure tunnel, has been provided by the Degnon Contracting Company, to whom this contract was awarded. The building is located near Forest Glen, N. Y., and contains an operating room, dispensary, general ward, isolation ward, kitchen and servants' quarters, and quarters for a resident surgeon, who spends his entire time on the work.

CONSERVATION OF LIFE IN COAL MINES

At the Spokane meeting, September, 1909, of the American Institute of Mining Engineers, a notable paper on "The Conservation of Coal in the United States" was presented by Mr. Edward W. Parker, of the U. S. Geological Survey. Mr. W. L. Saunders, of New York, contributed to the discussion of the above paper, in part, as follows: Mr. Parker's paper, though entitled the Conservation of Coal, might also be called the Conservation of Life in Coal-Mines. That the casualties in the coal-mines of the United States should have exceeded 3,000 in the year 1907 is simply appalling, and that 1,000 men should have been killed in a single year through explosions alone, points to the importance of activity not only among mining engineers but also by the legislatures of the respective states.

There is but little doubt that nearly all the serious coal-mine explosions which have taken place in the United States during the past 10 years have been due to coal-dust alone, or to coal-dust and gas mixed, and that the ignition has been caused by blown-out shots. If, then, the blown-out shot is such a deadly agency, it is natural to ask whether or not it is preventable, and, if preventable, how? If the hole is drilled in the proper place to the proper depth, charged with the right amount of powder, and properly tamped or stemmed, a blown-out shot is an impossibility, providing, of course, the coal has been properly prepared for blasting. If, then, the application of ordinary skill and experience would eliminate this frightful danger, why is it not done? Because the modern mine-crews are largely made up of men who are inexperienced, unskillful, and densely ignorant. These men are allowed to drill their own holes and to charge and fire them, notwithstanding that the lives of all the men in the mine are depending on the good judgment of each individual man. At many places all the men have to be out of the mine before the shots are fired, and this dangerous work is performed by shot-firers. During 1907 12 shot-firers lost their lives by explosions in Illinois.

That State produces more than 40,000,000 tons of coal per annum, and in 1907, out of a little more than 40,000,000 tons mined, nearly 25,000,000 tons were blasted from the solid; the bill for powder amounted to $2,208,343, and represented 1,261,910 kegs. It is interesting to note that where the coal was undermined by machinery, each keg of powder produced 96.02 tons of coal, while from the solid each keg blasted only 25.78 tons.

WHAT IS A BLOWN-OUT SHOT?

Perhaps the simplest description of a blown-out shot is one that does no useful work in shattering or blowing-down the coal, but blows out its tamping and projects a long vivid tongue of flame into the chamber where it is fired, the floor and sides of which are usually covered with coal-dust. This coal-dust is raised in clouds by the concussion, in this diffused condition it is easily ignited, and an explosion occurs which goes through the mine with inconceivable rapidity, carrying with it death and destruction, the extent and violence depending on the amount of dust and of good air (oxygen) in the mine. If 1 or 2 per cent. of fire-damp (CH_4) is present in the air, the dust ignites more rapidly. Until recently it was a disputed question as to whether coal-dust could be exploded in the absence of fire-damp, but this question has been settled beyond controversy by physical tests which have been made, in which thousands of people have seen coal-dust without any admixture of gas exploded by using a cannon-shot to represent the blown-out shot, and an iron tube 100 ft. long and 6 ft. in diameter to represent a mine gallery. Coal-dust is strewn on the bottom and on shelves along the sides, the cannon loaded with black powder and stemmed with fire-clay is fired into the tube, and a terrific explosion occurs.

It also has been demonstrated by this method that there are many explosives which do not ignite coal-dust as readily as black powder, on account of the very much shorter flame produced, and these are consequently much safer to use in mines; but as no explosive is flameless, this does not promise perfect immunity.

PROPERLY PREPARING THE COAL.

A blown-out shot occurs when the tamping is the path of the least resistance. This is likely to happen when the hole is drilled beyond the undermining, or when it is drilled on the rib, away from the undermining, or where blasting from the solid is practiced entirely. In some cases it is the result of carelessness; in many the result of ignorance; in some of neither, but of improper preparation of the

coal. In thick seams, where the undermining is done with chain-machines, where the undercut is 6 or 7 ft. deep and 4 in. high, the hole is generally drilled in the rib at such an inclination that it will touch or nearly touch the roof at the back. In this case the coal is not properly prepared; it is almost as bad as blasting off the solid, in some cases worse, for the way the hole is drilled makes it more dangerous. Many of the most disatrous explosions have occurred exactly under these conditions. The most destructive colliery-explosions which have occurred in recent years have been caused by blown-out shots, where the coal has been mined with chain-machines. Harwick, Monongah, Darr, and Marianna are notable examples. In these four explosions nearly 1,000 lives were lost.

The truth is, that undermining coal is not a sufficient preparation for blasting; it should be sheared on one side or in the middle. In this condition less than one-half the powder would be necessary, and less than one-half of the smoke would result, giving better sanitary conditions, and less danger of falling roof, which is a prolific cause of injury and death. All the coal would be in a better condition for handling and rehandling, giving much less slack at destination, and a positive gain of at least 20 per cent. more lump.

The value of shearing in the preparation of coal is recognized by mining engineers, mine-superintendents, and mine-foremen, as well as by coal-oeprators; but because they think it adds to the cost of production, they are willing to forego the advantages. It would add little, if any, to the cost of coal, for when lump coal is worth from $1 to $1.40 per ton and slack is worth from 20 to 40 cents per ton at the mines, while shearing will increase the more valuable coal by 20 per cent., and the cost of shearing with approved shearing-machines, would be about 6 cents per ton, it is not hard to figure what is would cost.

FALLING ROOF.

Shearing will be universal some day, and it will be a blessing to the workman and to the operator, and to all interested in the conservation of our national fuel-supply.

It is likely that in a comparatively few years the vast bulk of our bituminous coal will be produced without explosives of any kind; it will be excavated and loaded by mechanical means entirely, reducing explosives to a disappearing minimum, and so reducing accidents by falls of roof that a death through this cause will be as rare as it is now frequent.

A great many more deaths result from falling roof and coal than from all other causes combined, but little notice is taken of them because the fatalities occur only one or two at a time, and are scattered all over the coal-regions. This great loss and waste of life should not be less appalling because there is nothing spectacular about it. The sorrow and suffering are just as acute, there are just as many widows and orphans, just as many bereaved fathers and mothers, as if the lives were lost in explosions, and just as earnest efforts should be made to prevent deaths from this cause as from any other. It is easy to say that in most cases it is carelessness or ignorance, or both; but this does not relieve us from responsibility, especially if ignorance is the cause, for if we employ workmen who are ignorant it is our duty to teach them, and so to safeguard their lives that they shall not lose them through ignorance. Fully 95 per cent. of all fatal and non-fatal accidents caused by falling slate or coal take place in the working-faces where the miners are engaged in digging or loading the coal. In some mines the roof is naturally bad, and should be carefully and systematically timbered, the props having over them stout, broad cap-pieces, presenting a wide surface to the roof and set at near the face as necessity may demand. If this is done the miner can work between the props with perfect safety; but as he looks on this work as being unproductive, he will not take the time, or he may feel indolent and neglect to make his working-place safe. To overcome this, there must be stringent rules compelling systematic timbering after an approved method, which would make all working-places safe. One of the most prolific causes of falls of rock and slate in the faces is blasting, especially where the coal is undermined by chain-machines, or where blasting off the solid is practiced, as exceptionally large shots are necessary. These shots jar to such an extent that the roof, which before was comparatively safe, becomes loose and dangerous and too often the miner goes into a place which has been thus rendered unsafe and commences to load coal under a roof which may come down, and which frequently does come down, maiming him or crushing out his

life. At least 75 per. cent. of these accidents can be avoided if the mine-managements adopt proper methods which are rigidly enforced. As already indicated, one method is in systematic timbering; if in addition to this all blasting from the solid is made a criminal offense, and blasting is permitted only when the coal has been undermined and sheared on one side, then the roof would sustain but little, if any, injury from powder-shocks. If this precaution were observed, and a man were employed to visit each place once (or, if necessary, twice) a day, making sure that all the rules are enforced, deaths by falling roof would be rare, instead of daily, occurences. In the North of England one man, who is called a Deputy, is employed for every 20 or 30 men. His business is to look after their safety, to visit every place as often as necessary, each shift, to see that each place is amply supplied with timber of proper length, and in cases of peculiar danger to set it himself; he carries an axe and saw, and is always ready for emergencies. These miners are to the manner born; they come of long generations of miners, and in all the world there are none more skillful or intelligent, all speaking a common language. If it is necessary to throw such safeguards around them, how much more necessary it is where we have such a lack of skill, such dense ignorance, and so much difficulty in oral communication.

MANUFACTURE OF LIQUID AIR

It is stated that in his pioneer experiments in mechanical flight Langley employed a small steam engine, but that the water required for a five minutes run exceeded the weight of the engine itself, and in addition to that there was the steam generator and the fuel. Later developments with internal combustion motors have improved vastly upon that, but the reduction of weight of water and appurtenances is still the problem of extended or continuous flight.

Many amateurs are working upon model aeroplanes with sometimes interesting results. One writer in *The Model Engineer and Electrician* wishing to store as much energy as possible and to keep down the weight of the container has tried liquid air. The advantages, as he reasoned it, are—that a given weight of air occupies in its liquid state only one eight hundredth of its normal volume, and because it was only necessary to keep the reservoir at the working pressure it could be kept comparatively light. One reservoir was built of tinplate, with dished ends sweated together, and as it was well made, it was frequently worked at 150 lbs. per sq. in. pressure. The liquid air was poured in an opening, which was afterwards closed by a piston safety valve. The heat, which passed in through the container, caused the liquid to boil, and the air passed through an aluminum tube, which was coiled twice round the reservoir to the engine. The air was able to get away through the engine, so the pressure was kept low—indeed, it was only about 30 lbs. per sq. in. The reservoir was then fitted with a very thin aluminum casing, which carried two or three sponges, soaked in methylated spirits, at one end. The spirit was lit, and as the boiler was placed in the draught from the propeller, a blast flame played along the boiler and on the coils through which the air passed to the engine.

Having dealt with the objects for using the liquid air in this case, it is now intended to describe a small plant for its manufacture. But it should be clearly understood that the proposal to use liquefied gases for generating power is absurd, except in a special case like that described above, in which the cost was a secondary consideration.

Air must be reduced to a definite low temperature in order to liquefy it, because above this point no pressure, however large, will suffice. If it be reduced to another—lower—definite temperature, it becomes liquid at the ordinary atmospheric pressure. It is then in the state in which it is kept in storage. At any given temperature between these two there is a definite pressure which will liquefy the air. In practice the air is compressed to about 180 atmospheres, and is cooled to a temperature near that of liquid air. When in this condition it is allowed to expand through a small orifice, and the sudden expansion cools the air still further, so that part of it is liquefied.

The apparatus described is known as the Hampson type air-liquefier, and produces about 1 1-3 litres (say quarts) of liquid per hour. A diagram of the general arrangement of the apparatus is given in Fig. 1. It is necessary to free the air from moisture and carbonic acid, because at the lower temperatures attained, these become solid, and, if present, choke the apparatus, especially the small orifice which

has been mentioned, which is a needle valve, and the valve spindles and screws. The air is drawn through a low-pressure purifier, which contains slaked lime, by which carbonic acid is absorbed. From the purifier the air passes through a large tube to the compressor, from which it is delivered at from 150 to 200 atmospheres. The compressor cylinders are lubricated with water, and consequently some moisture is carried over in the compressed air. A separator is therefore provided, after the compression, to collect most of the water mixed with the air. As a final precaution the gas passes through a steel bottle charged with caustic potash, in which all remaining traces of moisture and carbonic acid are absorbed. The air next passes through the liquefier, in which it is first cooled, and then allowed to expand through a small orifice. A part of the air is liquefied, and the remainder, which is at a temperature almost as low as that of the liquid air, passes around the coils which convey the compressed air to the orifice. The exhaust is connected to the low pressure purifier, because this air has been purified, and by using it again, with fresh air only as the make-up, the charges in the purifiers are found to last for a considerable time.

The low pressure purifier is a galvanized iron cylinder, with an outside through connection to allow the exhaust air from the liquefier to pass direct to the compressor. There is a cock at the bottom of the cylinder to regulate the supplementary air, which replaces the air that is liquefied. This make-up air passes over the lime, which is supported on trays, and joins the liquefier exhaust at the tee-piece at the top of the purifier. The mixed air passes to the compressor through a large rubber tube.

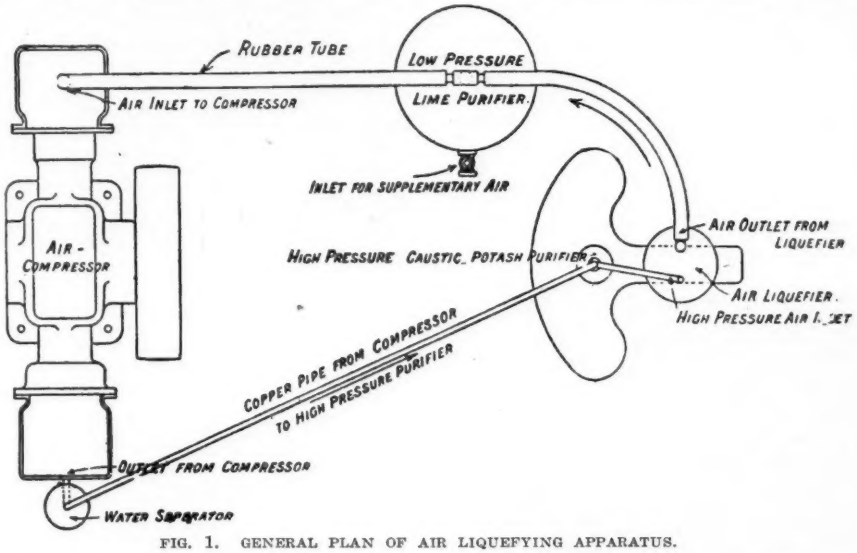


FIG. 1. GENERAL PLAN OF AIR LIQUEFYING APPARATUS.

THE WHITEHEAD COMPRESSOR.

The compressor illustrated in Fig. 2 is of the Whitehead type. It is here shown belt-driven, but it is also made direct coupled to an electromotor. It is capable of compressing 550 cu. ft. of air per hour to a pressure of 200 atmospheres, running at 400 r. p. m., and then requiring 6 h. p. to drive it. The compression is two-stage, the cylinders being opposite each other, and the crank between operating both pistons. The cylinders are surrounded by water contained in troughs bolted to the main casting. The air when compressed in the low pressure cylinder passes through a coil of tube which encloses the cylinder and is immersed in the water jacket. The air is thus brought down to the water temperature before entering the high pressure cylinder. After compression it passes through another cooling coil in the outlet pipe.

The relief valve on the high pressure cylinder is a very important feature, because the valves occasionally stick, usually on account of the fiber washers breaking, and warning is then given by this safety valve blowing off at each stroke with sounds like rapid pistol shots.

The compressed air passes through the separator and the purifier, both of the simplest construction, to the liquefier.

This is shown in the half tone, Fig. 3, and the vertical section, Fig. 4. The air passes down through the coils *B*, and is allowed to escape through valve *C*, which is regulated by a hollow spindle *D*, to which a hand wheel *E* is attached on the top of the apparatus. The compressor is started to work with all valves open, including the expansion valve *C* and the liquid air discharge valve P. The air is allowed to blow through for a short time to dry the coils. The valve *P* is then closed, and the expansion valve *C* is closed, or nearly so, to allow the compressor to raise the pressure to about 180 atmospheres. The moisture which collects in the water separator is blown off at intervals of five minutes whilst the compressor is working, a valve being provided for this purpose. When the required pressure is attained, the valve *C* is slowly opened until from 6 to 8 cub. ft. per minute pass through the liquefier. This is adjusted by reference to a glycerine gauge *L*, which records the pressure at the outlet. The efficiency of the plant appears to be very nearly constant over a fairly wide range of inlet pressure and rate of flow, as indicated by the glycerine gauge. The air expands to nearly atmospheric pressure on passing the valve *C*, and its temperature falls. The cold air passes back over the regenerator coils *B*, and the compressed air approaching the expansion valve becomes steadily colder for about ten minutes, when part of the air commences to liquefy and collect in the receiver *G*. The apparatus has then almost reached its steady working state, and liquid air may be collected at the rate of a bottle (1 1-3 litres) per hour.

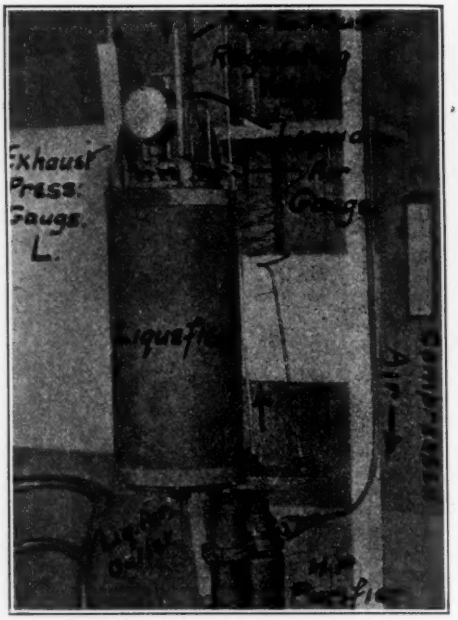


FIG. 3. SEPARATOR AND PURIFIER.

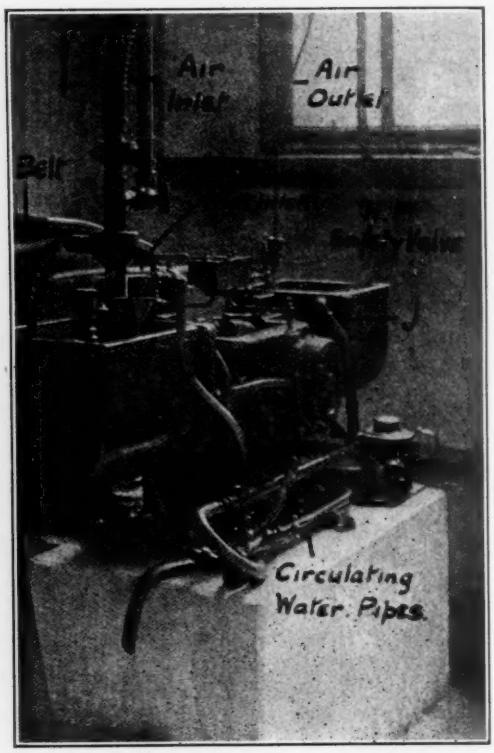
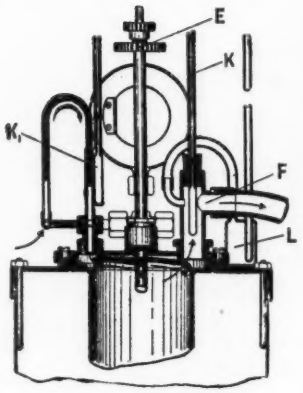


FIG. 2. WHITEHEAD TYPE AIR COMPRESSOR.

When the expansion valve is closed, and the compressor is working to raise the pressure, the thermometer plug at *K* is taken out to prevent air being sucked through the glycerine gauge *L*, because no exhaust air is then passing over to the compressor. It is also necessary to frequently move the valves *C* and *P* when the apparatus is cooling down, because, even if the air be pure, so that the valves do not freeze up, the unequal contraction might fasten them.

The liquid air is drawn off at intervals of about 5 minutes, or when about 100 cc. have collected. This is indicated by the colored water in the



PART SECTIONAL VIEW OF TOP.

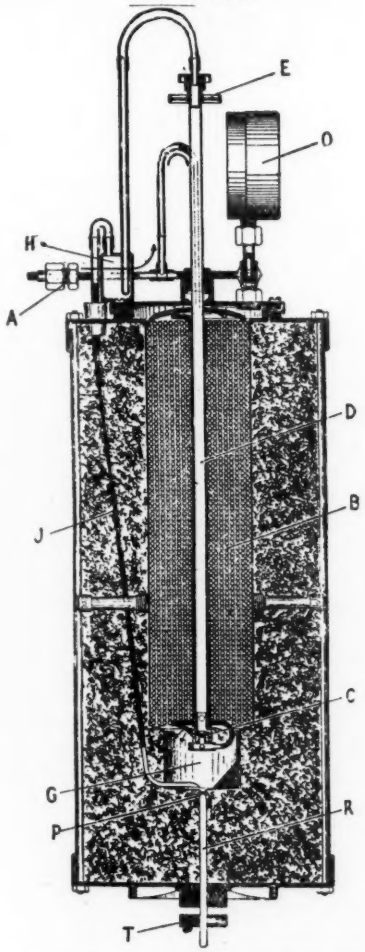


FIG. 4.—FULL LENGTH SECTIONAL VIEW OF AIR LIQUEFIER.

gauge *H*. This gauge is in communication with the receiver through the pipe *J*, and the hollow spindle *D* of the expansion valve *C*. When liquid air collects in the receiver *G* it compresses the air in the pipe *J*, and so displaces the coloured water in the gauge *H*, causing it to rise in the vertical indicating tube. Liquid air is drawn off through the hollow spindle *R* by turning the wheel *T*, and thus opening the valve *P*.

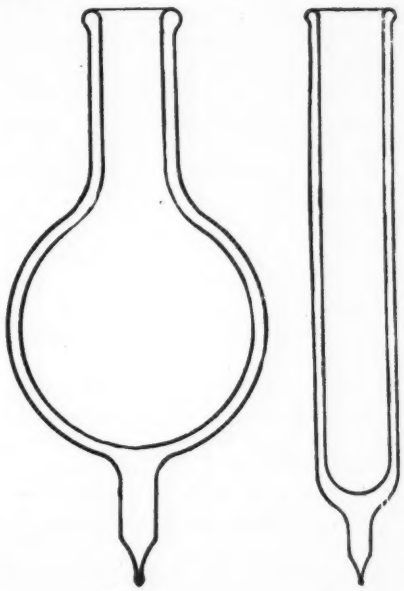


FIG. 5*a*. FIG. 5*b*.

Before closing down, when there is still some pressure in the apparatus, a valve at the bottom of the high-pressure purifier is slightly opened to blow out the collected water with its dissolved caustic potash.

The liquid air is collected and stored in a glass vessel illustrated in Fig. 5*a*. It consists of a double walled flask, and the air is extracted from the space between the walls. Sometimes a little cocoanut charcoal is placed in this space, because it absorbs the residual air when it is cooled by the liquid air. The vacuum prevents heat passing into the liquid, which would cause it to boil away, and the walls of the vessel are silvered with a similar object. Demonstration vessels are also made of the shape shown in Fig. 5*b*, and these are supplied either silvered or not. It takes about seven days for a full litre bottle of liquid air to completely vaporize away. Liquid air may be bought in many of the large towns of Great Britain.

THE EFFICIENCY OF COMPRESSED AIR

By Snowden B. Redfield.

"What is tthe ratio of the work represented in the compressed air to that done by the compressor?" This is a question often asked and it is a difficult one to answer clearly.

It is fairly well known that the energy transformation in the use of compressed air is not high, but the fact that it "does things," some of them better than by any other means and some which are not done by any other means at all, makes the matter of fuel economy of secondary importance. No apology is needed for the use of compressed air to-day.

That this matter of the fuel economy is not well understood is evidenced by the repeated appearance of propositions to develop the power of a water fall in the form of compressed air and transmit this through pipes to some distant point where its energy, like that of electricity, is supposed to be turned back again into work.

Such power transmission propositions as this are absurd, because the losses in the compression and expansion of the air reduce the power efficiency to too low a point. These losses are not losses of pressure by friction, nor air by leakage, but losses due to heating and cooling.

It is not a difficult matter to prove that all of the work of compression goes into heat and is lost in pipe-line radiation. All of the work performed at the far end comes from the intrinsic heat originally in the air, and the economy obtained depends entirely upon how the air is used. The actual cold compressed air traveling in the pipe does not at all represent the energy put into it by the compressor, as this has all been lost in radiation, and the only answer to the question first propounded, is: "Nothing."

However, we all know that the air does work, and this may be compared to the compressor work (although they have no direct relation) and in this way an "efficiency" may be stated.

In almost all cases compressed air is used in some form of reciprocating cylinder without expansion; indeed if expansion were allowed (unless reheating is resorted to) while the air could then give up more work, the moisture always present in the air would quickly freeze, choking the exhaust ports and passages of the machine with ice.

As examples of machines using air with little or no expansion, rock drills and pneumatic tools may be cited, and some interesting figures as to the efficiency of the power transformation, are given by the accompanying diagrams.

While actually indicating the drill or tool cylinder would be difficult, some rough idea of the indicated horsepower developed within it may be obtained by a little figuring, together with some judicious guessing.

Indicator diagrams of such machines would theoretically be rectangles, but wire drawing and cushioning effects of the valve mechanism would considerably modify this. It may be assumed then, reasoning from such a thing as a steam pump cylinder, without cutoff, that the diagram factor will be about 80 per cent. In other words the actual mean effective pressure will be about 80 per cent. of what the theoretical rectangular diagram would give.

On this basis it is determined that a standard rock drill having a 3-inch diameter cylinder will develop about 6.2 indicated horsepower with 100 pounds at the throttle, this decreasing with the pressure supplied, down to about 3.7 indicated horsepower, with only 60 pounds pressure.

A 3-inch rock drill will require about 138 cubic feet of free air per minute with 100 pounds pressure at the throttle; this decreasing to 90 cubic feet, with only 60 pounds pressure.

Knowing the quantity of air and the pressure, the compressor horsepower is easily calculated.

Thus, allowing 10 pounds pressure drop in the pipe, a 3-inch rock drill will require 29.8 indicated horsepower in the steam cylinders of the compressor with 100 pounds pressure and single-stage compression, or 25.2 indicated horse-power with compound compression. These figures reduce as the pressure used is reduced, but this, of course, reduces the work done by the tool.

Comparing the probable indicated horse-power developed inside the drill cylinder with the actual compressor power required to furnish the air, gives the probable efficiencies shown by the chart. These efficiencies are referred to both the air and steam cylinders of the compressor, so as to give a basis for calcula-

tions for various methods of driving the compressor. They include 10 pounds pressure drop in the pipe line.

Referred to the air end of the compressor, it is thus seen that with single stage compression and 100 pounds pressure, about 23.5 per cent. efficiency is obtained, increasing to about 29 per cent. with the low pressure of 60 pounds. Compound air compression brings these figures up to 27.8 per cent. with 100 pounds and 31 per cent. with 70 pounds.

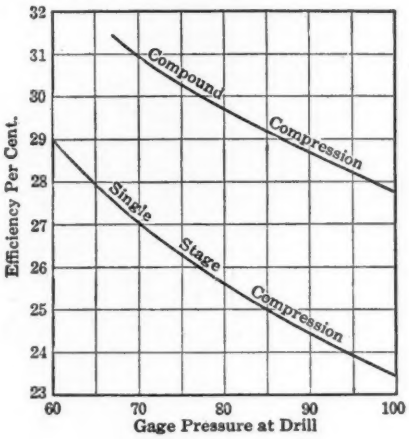


FIG. 1. PROBABLE EFFICIENCY REFERRED TO AIR END OF COMPRESSOR

Referred to the steam end, allowing 88 per cent. mechanical efficiency between the steam and air ends of the compressor, single-stage compression gives a little less than 21 per cent. efficiency with 100 pounds and about 25.5 per cent. with 60 pounds air pressure. Compounding the air cylinders of the compressor increases these figures to about 24.5 per cent. with 100 pounds and almost 27½ per cent. with 70 pounds air pressure.

While these figures for efficiency have been determined for rock drills in particular, they apply equally well to almost any machine using compressed air without expansion. It must, however, be remembered that the figures are based upon indicated horsepower only, both in the drill and the compressor. This is because of the impracticability of measuring the "brake horsepower" of the drill. If, however, brake horsepower efficiency is required, these figures for efficiencies of indicated horsepower can be multiplied by the mechanical efficiency of the device using the air, say 90 per cent. or 80 per cent., as the case may be. This, of course, gives a still smaller result.

It is to be noted that the higher efficiencies are obtained with the lower pressures. This is because there is less loss by heating the air during compression, and therefore it is advisable to use pressures as low as is consistent with the size and weight of the machine required to do a given amount of work.—*American Machinist.*

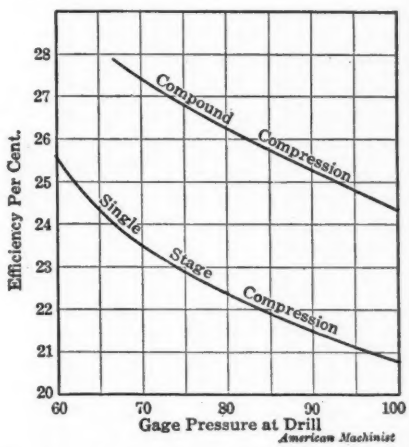


FIG. 2. PROBABLE EFFICIENCY REFERRED TO STEAM END OF COMPRESSOR

EXCESSIVE VENTILATION MAKES A DRY AND DUSTY MINE

"An Engineer and Mine Manager," name and address not given, writes as follows in *Mines and Minerals:*

A prominent English mining authority says (I quote from memory): "No mine is well ventilated that has less than 1,000 cubic feet of air per man per minute circulating through its workings." The term, "well ventilated," is certainly only relative. It is easy to believe that 1,000 cubic feet of air per man per minute would not be excessive in some mines that generate large quantities of explosive gas; but what is the effect in a mine in which explosive gas is not generated in sufficient quantities to be detected, or in a mine which generates very little explosive gas? Would not the amount of air called for by the above rule add to a non-gaseous mine a marked factor of danger?

This vast volume sweeping through the entries and workings in the winter time would

absorb an appreciable amount of the natural moisture of the mine and might change a damp mine into a dry and dusty one. It would also distribute the coal dust widely, and keep it stirred up, and if there happened to be a windy shot or an accidental ignition of powder, a dust explosion of magnitude might be the result.

It has taken a long time to educate the managers of some mines to equip them with ventilating apparatus which will furnish more than barely the legal quantity of air to the workings, but has not their education been overdone in the past few years, and are not the managers and engineers of large mining operations now going to the other extreme? Are they not putting too much air into some of their mines and thereby increasing the liability of dust explosions in the winter months by drying them out with an unnecessarily large ventilating current?

Consider for example a mine generating in one portion a small amount of explosive gas and having, say 500 inside employes. The Pennsylvania law requires for this mine a minimum of 150 cubic feet of air per minute, or 75,000 cubic feet of air in circulation. At the present time the management would probably provide, to be on the safe side, from 150,000 to 300,000 cubic feet per minute. Assume that the amount of air in circulation is 200,000 cubic feet per minute, which would for a considerable time during the winter months in Pennsylvania, enter the mine at a temperature of say +22° F., and also that the intake air is fully saturated with moisture and that the temperature of the mine is +62° F.; assume further that the ventilating current before it is discharged from the mine will absorb moisture until it is 90 per cent. saturated; in this case the ventilating current is removing moisture or water from the mine at a rate of 840 gallons per hour or 85 net tons per 24 hours. This drying out of the mine must materially increase the extent and destructiveness of an explosion, should one occur, particularly if the mined-out area is comparatively small. There is such an excessive quantity of air flowing through the mine that there is no danger of a gas explosion, provided the air is properly distributed, but has not the mine been rendered more dangerous by this drying out?

The only way to keep a dry and dusty mine safe is by the removal of the carbonaceous dust and then dampening with water or by distributing chemicals which have great affinity for water. Under the best of conditions, it is practically imposible to remove all of the dust and to saturate thoroughly all parts of the mine. It requires such constant and conscientious work to remove the dust or thoroughly to dampen it that, without the utmost vigilance, portions of the mine are apt to be slighted. Under no circumstances would a competent person suggest that the volume of the air circulating in a real gassy mine be reduced to save the natural moisture, but there is no question that in many mines, including some that are classified as gassy under the law of Pennsylvania, excessive ventilation increases the liability of explosions. Is it not a question of balancing these factors?

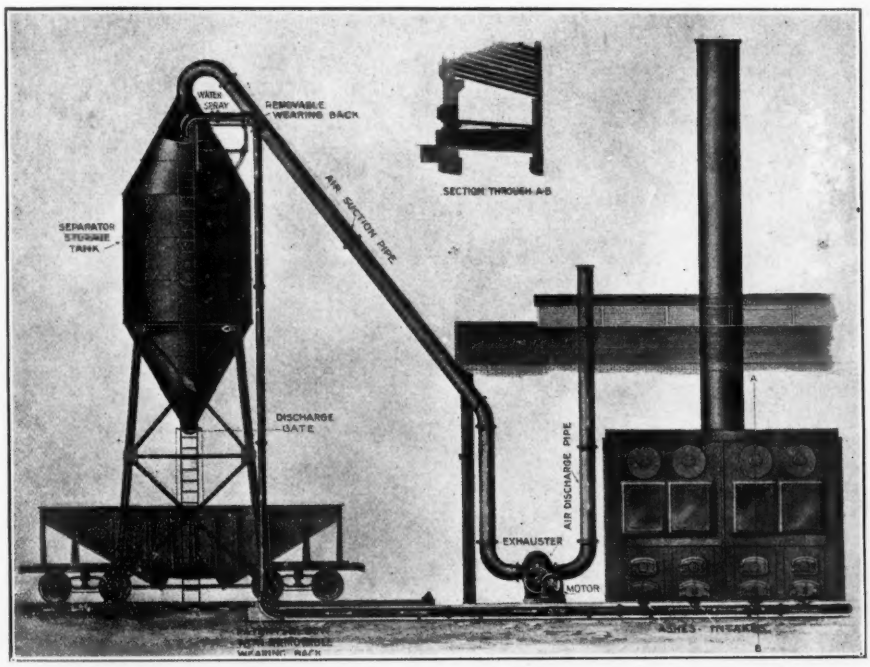
In some quarters, the above will be called rank heresy, but the entire trend of the late experiments and the conclusions reached by the best thinkers is that the drying out of some mines in the winter months by excessive ventilating creates a greater danger than would result from less ventilation.

In a number of mines in Pennsylvania, where a force fan is used for ventilation, the exhaust steam from the engines has been turned into the downcast with marked benefit to that portion of the workings first reached by the air. The result is that the air is heated quickly and the moisture of the steam is at the place ready to be absorbed into the air-current, or in other words, there is a certain amount of moisture put into the mine by the steam which is immediately absorbed by the air and, consequently, much less moisture is removed from the mine. If this plan were adopted and then supplemented by a number of fine sprays discharging water into the air at different places, until the air when it reached the tempreature of the mine is as nearly saturated as possible, there would be no more liability of mine explosions in winter than in summer.

In the tunnel through Bergen Hill, New Jersey, a No. 34 Slugger drill, with air at 90 lb., drilling hard diabase, which has a specific gravity of 2.98, was found to average 1 ft. of hole per hour. The rock was very "blocky," causing the drills to bind and stick badly. In normal trap the speed of drilling under like conditions is 1 ft. in 20 to 25 minutes.

A PNEUMATIC ASH ELEVATOR AND CONVEYOR

In any large boiler plant the removal of the ashes is an important item to be provided for, and it is no longer to be thought of as a thing to be done by hand. Traveling conveyors have been quite satisfactory for the purpose until the present when we may expect pneumatic apparatus to generally supersede them. The half tone shows the essential features of the pneumatic, or, rather, the suction ash conveyor system of the Darley Engineering Company, Singer Building, New York City. The arrangement of the details of course varies according to circumstances.



PNEUMATIC ASH ELEVATOR AND CONVEYOR.

Along the back or the front of the boiler battery—according to the arrangement of the boilers and ashpits—is run a horizontal pipe, which has a top inlet in front of each ashpit. These inlets are closed with stoppers, but when any ashpit is to be cleaned the stopper of the inlet is removed and the spout of a portable hopper is inserted, the ashes are then raked out into the hopper and fall into the pipe. The far end of the pipe is open to the atmosphere. The delivery end is continued horizontally and vertically to discharge into the top of an ash storage tank or bin, which may be of steel or concrete construction. At the discharge of the pipe is a water spray, which serves to cool the clinkers and wet down the dust. The vertical lift may be as high as 120 ft.

From the top of the ash tank a 22 in. suction pipe is led to a blower of the runner type, from which a delivery pipe is carried to the chimney. Centrifugal exhausters have been found less satisfactory than others. On the suction pipe, near the tank, may be an expansion chamber. The ashes in the tank are delivered through bottom spouts into carts or railway cars.

The conveyor pipe from the ashpit to the tank is from 6 in. to 10 in. diameter, and has 6 in. inlet openings. Large clinkers are broken by a shovel or bar as they are raked out. The pipe may be laid above or underground, as may best meet the conditions in each case. At all bends in the pipe there is, of course, liability of severe wear by the cutting and abrasion of the fine hard particles. This is provided for by using split elbow castings having an inserted wearing back of hard cast iron about 3 in. thick. These will last for from ten to eighteen months. In one case right-angle turns have

been used, the end opposed to the stream being closed by a cast iron plug, which is easily renewable.

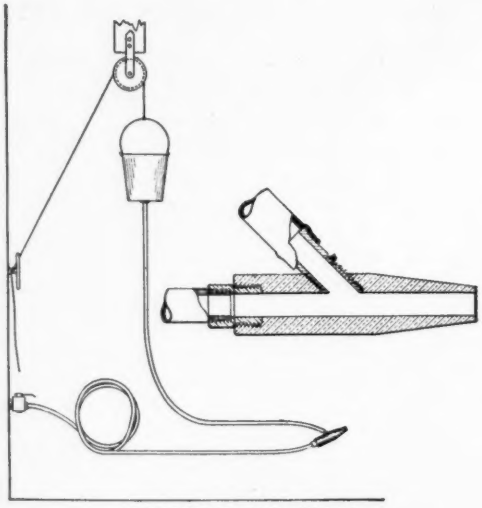
The main blast of air enters at the open end of the pipe, comparatively little being taken in at the ash inlets. Two or more inlets may be open at one time, but, as a rule, there is only one man to attend to cleaning the ashpits, so that only one inlet is open. The delivery of the ashes is from 200 to 500 lb. per minute, and they are best handled when dry, being wetted down only as they enter the tank. The suction pressure is from 16 to 32 ounces at the exhauster, and may drop to 4 oz. at the end of a long pipe. In a plant of 6,000 boiler H. P. one man on each shift takes care of the ashes, while formerly eight men were required on each shift to remove the ashes by hand. At another plant, the firemen clean the ashpits four times in twenty-four hours, and can dispose of all the ashes in 15 to 20 minutes at each cleaning.

The repair and renewal work is extremely small, and—contrary to first expectation—the conveyor pipes do not wear out. This is due to the fact that the tendency is for the material to be carried in suspension in the middle of the pipe, instead of travelling along the bottom. The system is being applied also to the conveying of coal.

A HOME-MADE SAND BLAST

By Frank Rose.

A novel sand-blast rig is in use at our shop and for a home-made device it is doing good work. We had a large number of castings, which had to be smoothed up nicely inside and, owing to their irregular shape, it was quite a problem to do the job as the specifications called for. Various methods were tried without success. Finally one of the men suggested buying a sand-blast outfit, but as we had compressed air and lots of sand handy, and were a little bit pressed for time, the foreman decided to let the man make his own sand blast rig. He took a piece of stock bronze about 2 ins. in diameter by 8 ins. long and, after turning one end down for a nozzle, drilled a small hole through the center of the piece from end to end. Another hole was drilled from one side, joining the center hole at an angle of 45 degrees, as shown in the sketch. At the end a nipple was screwed in and fitted to a copper pipe, which had three or four coils in it. This pipe was fitted to the main air pipe through a hand valve. The coils in the pipe were for convenience in handling the contrivance by giving it flexibility, so it could be moved in any desired direction. Another nipple was fitted at the side and to this was connected a rubber hose, which led to the bottom of an ordinary galvanized iron pail. Another nipple had been fitted in the bottom of this pail and the end of the rubber tube was attached to it as shown. The pail was filled with sand and by means of a rope attached to the handle, the pail was hoisted to a height of about 15 ft. and then gravity and the suction created by the compressed air rushing past the mouth of the rubber tube sent the sand out of the nozzle with sufficient force to clean up the surface upon which it was projected. Now an apprentice boy is regularly employed running the sand blast machine, which has been found to give excellent results.—*Modern Machinery.*

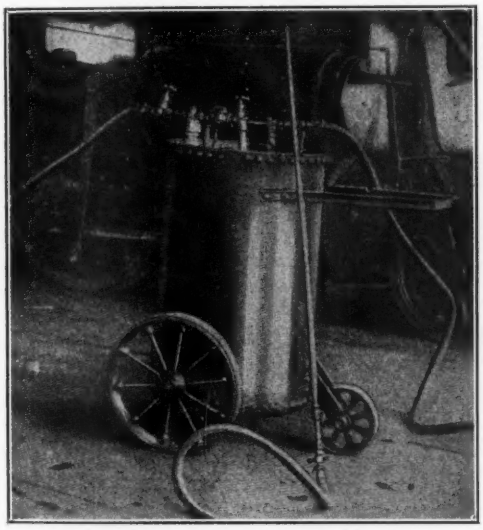


HOME-MADE SAND BLAST.

A LOCOMOTIVE FIRING-UP MACHINE

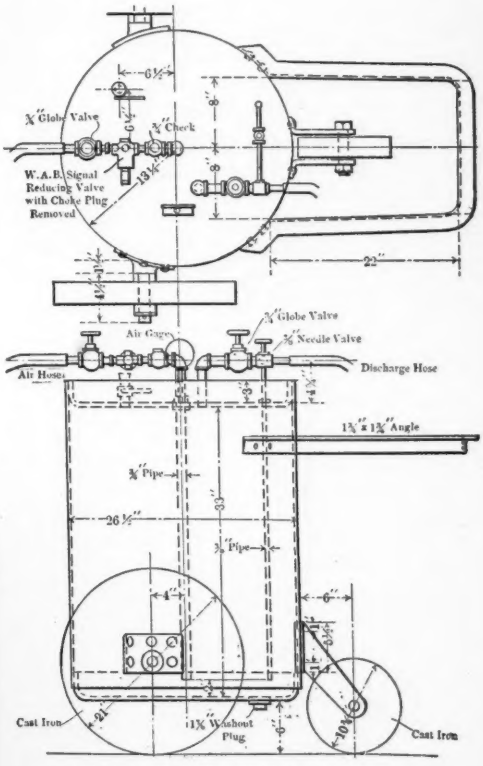
Starting the coal fires in locomotive fire-boxes by the use of crude oil is becoming quite general. This is usually done by soaking waste in oil and throwing it in on top of a light layer of coal in the firebox or by pouring the oil on top of the coal direct and lighting it. Either of these methods requires the use of considerable oil, and for the purpose of reducing this consumption, and also for reduc-

ing the time for igniting the coal in the fire-box, a machine is in use at the Ashtabula engine house of the Lake Shore & Michigan Southern Railway, which is shown here in two illustrations. This consists of a large tank, mounted on wheels to be easily transportable around the house, which is filled with crude oil. Air pressure is carried to the bottom of the tank through a ¾-in. pipe and the mixture of air and oil is forced out through a discharge hose, the main connection being made at the top of the tank; this is supplemented by a connection through a ⅜-in pipe which extends to the bottom of the tank and connects into the discharge line through a needle valve. This mixture of air and crude oil is then carried through a long flexible hose at the other end of which is connected a small pipe of a length which will reach to the front end of the fire-



LOCOMOTIVE FIRE LIGHTER.

box, the man handling it being on the deck plate. The end of this pipe has a small T and a number of small openings, and the air and oil mixture under pressure, discharging at the end is ignited and, being swept over the shallow bed of coal on top of the grate, quickly ignites it in all parts. About five minutes' work with this machine will start a glowing fire over the whole section of a large grate with the use of about one-half of the oil that would otherwise be required, and in less than one-quarter of the time.—*Am. Eng'r and R. R. Journal.*



PLAN AND ELEVATION OF LIGHTER.

IRON MINES OF NEWFOUNDLAND

What the gold reefs of Johannesburg are to the Transvaal the Wabana iron beds are to Newfoundland. They form immense deposits of rich red hematite ore, three miles long and several hundred feet wide, and showing 34,000,000 tons in sight above the water. The beds dip downward at an angle of 8 degs., and it is believed that they extend below the sea in practically unlimited quantity, though what is now in sight will suffice for a generation's work. To all intents and purposes the mine is an open quarry. The ore is got at by chopping off a surface of earth and rock, and then loosening the hermatite with charges of dynamite.

The deposit is one of Nature's freaks. It is a perfect reproduction of a tiled floor. Countless millions of cubes of mineral are laid out with rectangular precision, following the trend of the stratification, and these seem to have been cemented and forced together by some giant machinery in pre-historic days. Layer upon layer of these cubes are seen in a

vertical section of the mine, and the lines of cleavage are as clearly perfect as a child's box of blocks. The only difference is that one may not lift one of these mineral cubes with the fingers, but a dynamite charge fixed in a portion of the deposit by a steam drill shatters it for an area of many feet in every direction, and separates the solid mass into thousands of little bricks, each about 3 inches square and as perfect in alignment as if produced by an artist. No mining, in the customary sense, is needed. The deposit lies open to the sun, and all the work involved is the loosening of successive sections and the gathering up of the fragments, which is done by men shovelling them into ore cars, which run on a light cable railway to a pier on the sea shore.

The mine occupies the northern end of the island, and hard by is a sheltered cove, where a pier has been built whence 10,000 tons of ore may be loaded in a day. The laden cars run down an incline by gravity, and are upset automatically, their contents falling into one of ten pockets constructed in the interior of the pier. Each pocket takes a thousand tons, and can be emptied into a steamer's hold in ten minutes. The cost of mining the ore and putting it on shipboard is but 25 cents per ton, and the freight to Canada only 25 cents more, 50 cents being charged for its conveyance to Europe or the United States. It is in great demand in Germany, where ironmasters work it into very conveniently poorer ores, and large quantities of it are also absorbed at Philadelphia and Baltimore. The price at which it sells there yields the owners of the Wabana mine a profit of $1 a ton, and contracts for the delivery of 1,000,000 tons have been signed for this season.

COMPRESSED AIR FOOTBALL

The cut is from a popular daily newspaper and is intended to show the possibilities of a new game apparatus, the following being all the description offered:

"Upon the top of a light table a football "gridiron" is chalked or inked. Goal posts are fastened in their proper places. Each player has a bellows, which is worked by the foot, and a hose with nozzle attached. Tennis balls, or smaller rubber balls are blown about by the bellows. The sides have equal numbers of players, who take turns in blowing the ball toward the opponent's goal posts. Whenever

COMPRESSED AIR FOOTBALL.

a ball goes off the table, it is brought back and placed on the side-lines where it crossed. The side winning the greatest number of goals in a time agreed upon beforehand gains the victory."

Why not use the bellows and air jet instead of the cue for pool or billiards? The conditions of chance or skill in the game might be so changed as to render them unrecognizable.

EXTENSIVE NATURAL SAND-BLASTING

The power of the sand blast used in cleaning and renovating our smoke-stained buildings is an adaption of a natural agency which in past ages has done stupendous geological work. Few rocks can withstand the power of sand composed principally of silica or quartz when violently blown against it. The extraordinary monuments that characterize the plateaux of Utah and the Grand Canyon region, including the stupendous "Natural arches," are due in part to water and sand and in part to sand alone driven by the storms of the desert. The larger work, such as the cutting of profound canyons, was undoubtedly due to the erosive action of water carrying sand and pebbles in its grasp. The minor, but no less striking work, such as the whittling away of monuments and the production of top-heavy obelisks with perilously narrow bases, and of mushroom and other grotesque rock forms was largely due to the sand blasts of the desert. Any one who has been exposed to a desert storm knows the sharp cutting effect on the face and hands of blowing sand. Windows facing the West in Colorado may often be observed to be etched or scratched. Carry on these agencies at intervals for hundreds or

thousands of years and the effect of blown sand on soft and even hard rocks will be very marked.

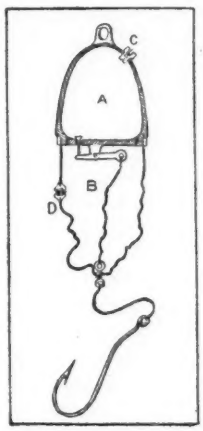
In watching the rapid effect of the sand-blast on our public buildings in Denver, the basements of which may be a coarse red granite, we are astonished that our buildings could be so dirty, or that so much smoky dirt could accumulate in so comparatively short a time, and at the difference between the original stone as it came from the quarry, and as revealed by the sand-blast and its present condition, so that we involuntarily say "look on this picture and on that." It would be a good thing sometimes for a mine examiner if he could use such a sand-blast to clean off the face of a mining tunnel and study the vein, so generally obscured by powder-smoke and dust, in its integrity. So powerful on rocks seems the effect of the sand-blast that we suggest to some inventive person a more extended use for it. It would seem as if here was a legitimate subject for the inventive mind.—*Mining Science.*

A CALCIUM CARBIDE SPRAYER

At a recent meeting of the Faraday Society a gas pressure sprayer, the invention of Mr. W. Tyree, of Sydney, N. S. W., was described. Although the device was introduced only about five years ago, over 5,000 are now in use in Australia. They are chiefly used for destroying all kinds of pests which run riot with fruit trees in Australia, but they are also put to such varied uses as spraying turpentine and zinc-white on the inside of feed tanks of boilers, for spraying disinfectants and for painting and distempering, and many other possible applications readily suggest themselves. The apparatus consists of two iron cylinders, in the larger of which is contained the spraying emulsion, while in the smaller the gas is made by water being allowed to drip at any required rate into the calcium carbide. The two cylinders are fastened together, and riveted to withstand a pressure of 200 lb., the acetylene being generated to only half this pressure, even this exceeding that permitted by the British Board of Trade. If some material could be found to give off a non-inflamable gas the usefulness of the sprayer would be greatly enhanced. As it is, the use of the sprayer in Australia has sent up the consumption of calcium carbide in Australia from 2,000 tons four years ago (at $90 per ton) to over 8,000 tons (at $50 to $60 per ton) last year, a quantity greater than that consumed in Great Britain.

A FISHERMAN'S SINKER FLOAT

The product of piscatorial ingenuity shown in the sketch perhaps shaped itself in the brain of a patient angler while sitting on the river bank waitng for a bite. It was contributed to *Popular Mechanics* by Mr. W. S. Jacobs, Malden, Mass.



The sinker proper is the little metallic chamber *A*, charged with air at a considerable pressure. It can be charged at the air valve *C* just as a pneumatic tire is inflated. Attached to the base of the sinker, all around, is the collapsible, and normally collapsed, bag *B*. Within the bag and fulcraned on the bottom of the sinker is a little lever, the short end of which is connected to an inwardly opening air valve in the bottom of the sinker, while the long end of the lever is connected through the bottom of the collapsible bag to the hook below. When the fish bites the lever opens the valve, the bag is distended by the air, the combined specific gravity of sinker and air bag becomes considerably less than that of the water, and in the long run, in spite of the objections of the fish, the contraption rises to the surface.

PATENTEE'S EXPERIENCES

Mr. Askin Nichols sends from Melbourne, Australia, to *Mining and Scientific Press,* San Francisco, a description or defense of his vacuum filtration process, concluding with the following paragraph:

After giving brains, time, and money to this, one naturally says, "What is the good of a patent office? Is it simply a Government institution to put people at loggerheads and to encourage litigation?" I do not intend these remarks to apply to the patent office of any

one country, as there has recently been an instance here (in the Commonwealth) of an important metallurgical patent, namely, the Potter process. After litigation extending over some years, and costing over £20,000, the Privy Council, the highest court of the British Empire, gave a verdict in favor of Potter, but the inventor himself is in his grave. The only thing Potter got out of his invention was worry and anxiety. So far my experience has been the same. Might I suggest for the consideration of international patents' committees that patents be granted with arbitration clauses where they overlap, but only for application in the case of the subsequent applicant introducing new and valuable matter. This would relieve many difficulties.

METERING AIR LIFTS

The city of Galveston, Tex., is installing an air meter at the pumping station and wells at Alta, Loma, for the purpose of measuring the air used in each of the 30 wells to raise the water used in the city. The air compressor plant installed about a year ago has a capacity of 1,200 cu. ft. of free air per minute. This compressed air is distributed to the wells which extend over a territory three miles long, but it is not known what each well gets. With the installation of the air lifting plant the capacity of the wells has been more than doubled. Formerly, and before putting in the air plant, the pumping station pulled on an average between 2,500,000 and 3,000,000 gallons a day out of the wells. It is now possible to pump and supply Galveston with 7,000,000 gallons a day. —*Municipal Journal and Engineer.*

PURE AIR FOR STREET CARS

The Chicago Health Department has submitted to the Council a new code for the regulation of street cars in which occur the following provisions:

"There shall be introduced into every car 350 cubic feet of air every hour for each passenger.

"The minimum amount of air to be introduced into a loaded surface or elevated coach shall be 28,000 cubic feet each hour.

"There shall be at no time in excess of one-tenth of 1 per cent. of carbon dioxide gas in the atmosphere which passengers have to breathe.

"The air shall be conducted into the car through the floor.

"Exhausted air shall be conducted out of the car through overhead ventilators, but no air shall be allowed to enter by that route.

"During cold weather the air which is admitted shall pass over heating coils and be warmed as it comes in.

"In any car or part of a car where smoking is permitted the supply of air shall be at least one-third greater."

How the volumes of air are to be measured, or tests of air conditions are to be made, do not seem to be suggested.

COST OF MANUFACTURING A MINING ENGINEER

The cost of producing a young mining engineer, from his birth to his day of graduation, has cost somebody—father, city, state or nation—not far from $10,000. Is it worth while to put this amount of capital into a mere artisan-engineer? I think not. It becomes a case of polishing bricks. But if this expenditure produces an artist-engineer, the nation has made a judicious investment, because the chance for the untrained or uneducated man to make a success in this age is practically nil. Taking "Who's Who" as a standard of national prominence it is found that it takes approximately 10,000 grammar school graduates to produce one man worthy to be enrolled in "Who's Who." Of High School graduates 250 will suffice, while out of only fifty college graduates one will, on the average, rise to sufficient prominence to be enrolled in this book. More evidence of the practical value of an education is hardly necessary. There is never an overproduction of artist-engineers, only a surplus of the artisan variety. *Victor C. Alderson, Pres't Col. School of Mines.*

Measured by selling values the production of natural gas in this country more than doubled between 1901 and 1908. The total volume produced in 1908 was 402,140,730,000 cubic ft., a decrease of about 2,500,000,000 cubic feet from 1907. Pennsylvania led with 130,476,237,000 cubic feet, West Virginia being second, 112,181,278,000 cubic feet; Kansas, 80,740,264,000; Ohio, 47,442,393,000, and Oklahoma 11,924,574,000.

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EVERYTHING PNEUMATIC

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CONTENTS

Mean Effective Pressure in Air Compressors 5643
Aerial Property Rights..... 5645
A Bath Tub for Mules..... 5645
Compressed Air Explosions in the Transvaal 5646
Air Operated Self-Dumping Scow..... 5647
Conservation of Life in Coal Mines.... 5650
Making Liquid Air..... 5652
Efficiency of Compressed Air 5656
Pneumatic Ash Conveyor 5659
Home-Made Sand Blast..... 5660
Locomotive Firing-Up Machine..... 5660
Iron Mines of Newfoundland..... 5661
Compressed Air Football..... 5662
Natural Sandblasting 5662
Calcium Carbide Sprayer..... 5663
A Fisherman's Sinker-Float..... 5663
Patentees' Experiences 5663
Metering Air Lifts 5664
Pure Air for Street Cars..... 5664
Cost of a Mining Engineer..... 5664
A Billion Dollars for N. Y. City Improvements 5665
Fatal Explosion of Oxy-Acetylene Apparatus 5666
"Star" Air Compressor 5667
Temperature Conversion Table..... 5668
Notes 5669
Patents 5670

A BILLION DOLLARS FOR NEW YORK CITY IMPROVEMENTS

According to plans now formulated, and with some of the work already under way, New York City has in view municipal improvements mostly in the engineering field and to be completed within the next fifteen years which will involve an expenditure of $1,000,000,000. In this estimate a great variety of work is of course included, without mentioning the Catskill aqueduct which is advancing rapidly towards completion.

Perhaps the most striking single item is the construction of an entirely new and adequate harbor which may eventually effect an entire rearrangement of freight and even of passenger traffic and tend also toward the relocation of residence and business centres. The harbor spoken of will be secured by the conversion of the shallows and marsh lands of Jamaica Bay into a sheltered but directly approachable harbor with an anchorage area of 25 square miles and providing for hundreds of miles of wharfage. This new harbor, besides providing improved facilities for the present and growing city trade, will also form an adequate terminal for the State barge canal now far under way for connecting the Hudson and the Atlantic with the great lakes.

New subways are planned to cost at the present figures $200,000,000, but before these are completed they will be inadequate for the ever growing travel and more will be wanted at once. Then there is the North River bridge and more tunnels. Improvements in another line are planned in connection with the city's means of surface transportation. This will involve the elevation or depression of intersecting streets at some of the busier points. Traffic on certain of the streets has now become so great that at certain points where they cross and interfere it will not be feasible much longer to have the streets on the same grade.

The work thus indicated is strictly municipal in character and there may be as much more demanded in the same time for the railroads and for corporate and individual needs. The unbuilding and the rebuilding of the city goes on continually, and this certainly shows no promise of abatement. At the present writing, a sixteen story building with pneumatic foundations and steel frame throughout, an entirely modern structure, is being torn down in the heart of the financial district to be followed by

the erection of another of nearly double the height and more than double the horizontal area, and so it goes.

By all this we are assured that whatever changes may come compressed air is sure of its job in New York City, for it is one of the agencies now first thought of and most constantly employed in all the lines of work here indicated.

FATAL EXPLOSION OF OXYACETYLENE APPARATUS

At an automobile repair shop in New York City there recently occurred a disastrous and somewhat inexplicable explosion of the oxygen tank and generator of an oxyacetylene welding apparatus, by which one man was literally blown to pieces and another severely injured, while apparently the acetylene had nothing to do with it. The matter was thoroughly investigated by one of the editorial staff of the *American Machinist* from whose account we condense as follows:

The acetylene used in this apparatus was generated in a tank in the usual way by the action of water upon calcium carbide, and the acetylene flame was used for heating two cylindrical retorts 4 in. diameter and 14 in. long for generating the oxygen which was conducted from them by a ⅜ in. pipe to a steel storage tank 14 in. in diameter and 6 ft. high. The retorts were closed at one end by a hemispherical head integral with the shell, and at the other by a screwed flange with a cover bolted on. One flange and cover was blown off by the explosion and the end of the shell was torn open about 2½ in. long, while the other retort was practically uninjured.

The really terrific explosion was that of the large oxygen storage tank. The side of this was torn open, not at the seam, but in the solid metal from end to end, and the sheet, which is about 3-16 inch thick, was bent completely back, literally turning the tank inside out. With an oblique, jagged tear one-half of the sheet was twisted and reversed end for end, and in one place a ragged hole seemed to show where in its passage through the roof of the building it was pierced by something hard and strong. One large piece was torn completely out of the sheet, this embracing about half the diameter and one-third of the height.

The explosion was not due to defective material, nor to a gradual increase of pressure above the normal to the bursting point, either of which causes would naturally be suggested. The access of pressure must have been sudden and, for the instant, far above the strength of the material. From the distribution of the damage effect it would at first appear that the explosion took place in the storage tank; and the instantaneous increase in pressure which may have occurred in this tank first, could have had full opportunity to destroy this tank, while the comparatively small diameter of the connecting pipe choked back the pressure sufficiently to produce only the comparatively slight damage to the generator, before the pressure was relieved by the explosion.

It may be contended, however, that the resulting destruction to the storage tank was the greater because it was so much larger and of so much thinner material relatively to its diameter. This is apparently perfectly possible, and so it is also possible that the explosion came from the materials for generating the gas in one of the retorts.

The fact that one generator was apparently uninjured seems to favor this theory, because we may in that case assume that the explosion started in the other generator, that the pressure then reached the storage tank with power enough to burst it while the small diameter of the pipe connecting the second generator and the relief of the pressure in the storage tank by its bursting both combined to save the second generator from the destructive access of pressure. What could have caused the chemicals to explode in the bursted generator it would be difficult to say, unless it was some entirely foreign impurity.

If the origin of the catastrophe is assumed to have been in the storage tank, there seems to be nothing to suggest the cause of the explosion. This tank was simply a cylindrical steel shell to hold the oxygen generated. The usual working pressure was about 150 pounds and this is assumed to have been the pressure up to the moment of the explosion.

Pure oxygen is nonexplosive. It is the active agent of the atmosphere and naturally will not burn in air. Oil, or other carboniferous substance, however, once ignited burn violently in oxygen, producing a high temperature, and pressure if in a confined space. It is possible,

therefore, that some such foreign substance was inside the oxygen apparatus and this, acted upon by the heat employed to generate the oxygen, caused ignition and explosion.

There was no connection between the acetylene generator and the oxygen tank, so it seems impossible that there could have been any mixture of the two gases inside the apparatus. As a matter of fact, the acetylene flame is said to have been extinguished by the explosion, the acetylene generator being unharmed. This fact and also that the building at once took fire, would seem to indicate that the explosion itself produced a flame.

A full knowledge of all the facts in this case, and a complete understanding of the sequence of occurences, should lead to a clear interpretation of the effects from the causes, and should ultimately result not in retarding the use of the valuable oxyacetylene process, but in surrounding it with increased guarantees of safety.

"STAR" AIR COMPRESSOR FOR MOTOR BOATS

The "put-put," or gasoline motor boat is rapidly driving the row-boat out of existence. Its speed, combined with the inconvenience of sudden or frequent stoppage, makes a ready whistle necessary, and the whistle calls for a constant supply of compressed air to blow it. The designer of the little compressor shown in Fig. 1, he being a provider of marine hardware and mechanical supplies for motor boats and recognizing this existing requirement, proceeded to supply it with the result here shown.

The compressor is a very simple combination of essential elements and requires little explanation. There is a plunger operated by the direct thrust of a cam on the propeller shaft, the bearings fitting the shaft on each side of the cam, and the cylinder lying horizontally or at any angle on either side of the shaft or standing vertical if so required. A light spring holds the plunger always in contact with the cam when compressing, so that there is no lost motion or backlash, while the plunger is instantly thrown out of action by the lever seen in front. The short end of this lever catches over the end of the plunger, and its face is sufficiently beveled to push the plunger entirely out of contact with the cam. Air sufficient to blow the whistle is produced in half a minute, although normally the receiver is kept filled with air up to 50 or 60 pounds. If it is not convenient to slip the bearings and cams over the end of the shaft, they are made so that they can be clamped on.

Fig. 2 shows a complete outfit as usually supplied, comprising receiver, pressure gage, whis-

FIG. 1. STAR AIR COMPRESSOR.

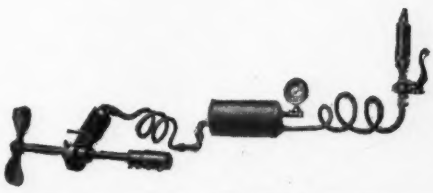


FIG. 2. WHISTLE BLOWING OUTFIT.

tle, copper pipe which can be bent to lead anywhere and all the necessary small fittings. Further detailed particulars are furnished by the makers, W. & J. Tiebout, 118 Chambers St., New York City.

cific purpose. By the adoption of the scheme often used in logarithmic tables, every unit of temperature from that of liquid air to the arc is included, and all the figures are exact instead of approximate, as might be expected.

C°	0	10	20	30	40	50	60	70	80	90
	F	F	F	F	F	F	F	F	F	F
−200	−328	−346	−364	−382	−400	−418	−436	−454		
−100	−148	−166	−184	−202	−220	−238	−256	−274	−292	−310
−0	+32	+14	−4	−22	−40	−58	−76	−94	−112	−130
0	32	50	68	86	104	122	140	158	176	194
100	212	230	248	266	284	302	320	338	356	374
200	392	410	428	446	464	482	500	518	536	554
300	572	590	608	626	644	662	680	698	716	734
400	752	770	788	806	824	842	860	878	896	914
500	932	950	968	986	1004	1022	1040	1058	1076	1094
600	1112	1130	1148	1166	1184	1202	1220	1238	1256	1274
700	1292	1310	1328	1346	1364	1382	1400	1418	1436	1454
800	1472	1490	1508	1526	1544	1562	1580	1598	1616	1634
900	1652	1670	1688	1706	1724	1742	1760	1778	1796	1814
1000	1832	1850	1868	1886	1904	1922	1940	1958	1976	1994
1100	2012	2030	2048	2066	2084	2102	2120	2138	2156	2174
1200	2192	2210	2228	2246	2264	2282	2300	2318	2336	2354
1300	2372	2390	2408	2426	2444	2462	2480	2498	2516	2534
1400	2552	2570	2588	2606	2624	2642	2660	2678	2696	2714
1500	2732	2750	2768	2786	2804	2822	2840	2858	2876	2894
1600	2912	2930	2948	2966	2984	3002	3020	3038	3056	3074
1700	3092	3110	3128	3146	3164	3182	3200	3218	3236	3254
1800	3272	3290	3308	3326	3344	3362	3380	3398	3416	3434
1900	3452	3470	3488	3506	3524	3542	3560	3578	3596	3614
2000	3632	3650	3668	3686	3704	3722	3740	3758	3776	3794
2100	3812	3830	3848	3866	3884	3902	3920	3938	3956	3974
2200	3992	4010	4028	4046	4064	4082	4100	4118	4136	4154
2300	4172	4190	4208	4226	4244	4262	4280	4298	4316	4334
2400	4352	4370	4388	4406	4424	4442	4460	4478	4496	4514
2500	4532	4550	4568	4586	4604	4622	4640	4658	4676	4694
2600	4712	4730	4748	4766	4784	4802	4820	4838	4856	4874
2700	4892	4910	4928	4946	4964	4982	5000	5018	5036	5054
2800	5072	5090	5108	5126	5144	5162	5180	5198	5216	5234
2900	5252	5270	5288	5306	5324	5342	5360	5378	5396	5414
3000	5432	5450	5468	5486	5504	5522	5540	5558	5576	5594
3100	5612	5630	5648	5666	5684	5702	5720	5738	5756	5774
3200	5792	5810	5828	5846	5864	5882	5900	5918	5936	5954
3300	5972	5990	6008	6026	6044	6062	6080	6098	6116	6134
3400	6152	6170	6188	6206	6224	6242	6260	6278	6296	6314
3500	6332	6350	6368	6386	6404	6422	6440	6458	6476	6494
3600	6512	6530	6548	6566	6584	6602	6620	6638	6656	6674
3700	6692	6710	6728	6746	6764	6782	6800	6818	6836	6854
3800	6872	6890	6908	6926	6944	6962	6980	6998	7016	7034
3900	7052	7070	7088	7106	7124	7142	7160	7178	7196	7214
C°	0	10	20	30	40	50	60	70	80	90

C°	F°
1	1.8
2	3.6
3	5 4
4	7.2
5	9.0
6	10 8
7	12 6
8	14.4
9	16.2
10	18 0

F°	C°
1	56
2	1 11
3	1 67
4	2 22
5	2.78
6	3.33
7	3.89
8	4.44
9	5.00
10	5.56
11	6.11
12	6.67
13	7.22
14	7.78
15	8.33
16	8.89
17	9.44
18	10.00

EXAMPLES: 1347°C = 2444°F+12°.6F = 2456°.6F: 3367°F = 1850°C+2°.78C = 1852°.78C

TEMPERATURE CONVERSION TABLE

The table on the opposite page, arranged by Dr. Leonard Waldo, 49 Wall street, New York city, is, we think, the most compact, convenient and complete ever devised for this specific purpose. By the adoption of the scheme often used in logarithmic tables, every unit of temperature from that of liquid air to the arc is included, and all the figures are exact instead of approximate, as might be expected. The conversions are also in both directions, from centrigrade to Fahrenheit and vice-versa, as may be required. The table as here presented is a photo-engraved reproduction from a page of *Metallurgical and Chemical Engineering*.

AN INTERNATIONAL CONGRESS OF INVENTORS

The first national convention of the International Congress of Inventors is to be held in Rochester, N. Y., June 13 to 18, 1910.

This organization was established in Rochester in 1906 and was incorporated 1907. Its purposes, briefly, are:

To establish a standing for a United States patent independent of any court action.

To procure necessary legislation, Federal or State.

To reform abuses and secure freedom from unlawful and unjust exactions.

To promote intercourse among the members.

To maintain permanent headquarters.

To present the solid front of a strong international organization for asserting the rights of members, individually or collectively.

To acquaint the members with what is going on in the world.

To give advice to members upon specific questions which arise.

To keep always prominent the mutual advantages of organization and cooperation.

In connection with and a part of the convention will be an exhibition of patents, comprising models of patents as samples of modern ingenuity, and complete machines and devices embodying patents for the purpose of commercial publicity, for the latter class of exhibits some charge being made for space. The Secreary is Ralph T. Olcott, Rochester, N. Y.

NOTES

By a recent count the average number of rock drills in use in the mines of the Rand is 3,258.

It is estimated that to completely scrap the British battleship Thunderer, built in 1877, will require the work of 100 men for nearly two years. The usefulness of this ship, as of many others, during the thirty-three years of its existence, has been entirely of the "moral" kind, as it has never appeared in war.

The rare non-metallic element selenium has peculiar properties. In the dark it is a poor conductor of electricity, but in the light it becomes a good conductor, and on account of this it is used in a number of electrical devices. It has been used in telephoning along a ray of light and also in transmitting pictures by telegraph.

It may be said to be now only a question of time as to the building of a tunnel in Boston connecting the station of the Boston & Maine and the New Haven roads, or, as they are locally known, the North and the South stations. Estimates of the total expenditure involved amount to $16,000,000.

Mrs. Elmer Woodbury, of Oakland, Cal., is the inventor of a man-operated street sweeper, combining the principals of the carpet sweeper and the compressed air or vacuum cleaning machine. The inventor claims that the machine is chiefly valuable for its sanitary features.

Professor Jos. W. Richards, of Lehigh University, says: "We feel confident in predicting that when a blast furnace is run on air enriched by 5 per cent. in oxygen, it will run normally one-third faster than when run with ordinary air, and will save probably one-sixth the fuel requirement."

The steel used in drilling the new tunnels for the Pennsylvania Railroad through the diabase mass of Bergen Hill, N. J., including that lost and scrapped, was almost exactly 1 ft. for each 10 cu. yds. of excavation, or 1¼ in. per cu. yd. The loss due to sharpening was the greater portion of this, being ¾ to ⅞ in. per cu. yd., the work being done with an "Ajax" sharpener.

C. Drucklieb, 178 Washington street, New York City, has disposed of his interest in the manufacture and sale of the Injector Sand Blast Apparatus to James M. Betton, who has had the practical management of this branch of his business for the past five years. The business will be carried on, as heretofore, under the name of J. M. Betton, at 178 Washington street, New York City.

On March 2, shortly before midnight, a powder magazine exploded in the "Mexican" shaft of the Treadwell gold mines on Douglass Island, near Juneau, Alaska. Within 30 ft. of the magazine a group of miners was assembled

waiting for the cage to take them to the surface, and 31 of them were killed outright while two died later from injuries. The magazine contained about 275 lbs. of powder. The Treadwell mine employed about 1,400 men.

Vice-Consul-General J. J. Slechta writes that plans have been completed for installing in Rio de Janeiro a modern pneumatic-tube system for transmitting telegrams and other messages. The topographical position of the Brazilian capital necessitates its separation into distinct and widely separated districts, between which communication is slow, because of the circuitous route, to avoid mountainous districts, either by tramway or other street vehicle.

A process of disinfection has been recommended by Dr. Le Faguays which is to consist in blowing upon the contaminated surfaces a current of air heated to a very high temperature (600 to 900 deg. F.). This process may be applied not only within buildings, but also to the surface of streets, yards, etc. The apparatus is heated by petroleum and is very simple. This process not only destroys disease germs, but it is very efficacious against fleas and other vermin.

Secretary Ballinger of the Interior Department, in a recent address at St. Paul, Minn., said that while the doctrinaires figure that the coal deposits of the United States and Alaska will be exhausted in a period of 100 years the fact is that, according to the production of coal in the United States at the close of 1908, only 0.4 of 1 per cent. of the original supply of coal had been exhausted, leaving us the apparent supply still available 99.6 per cent. of the original supply, or coal enough to last, as some assert, for a period of 7,000 years."

A novel use for Thermit was found last year by the Chicago, Great Western Railroad when it was decided to change the stroke of some of the locomotives. To do this it was, of course, necessary to fill up the crank-pin holes of the driving wheels, and to bore new holes at the desired distance from the center for the new stroke. The Thermit process was used for filling the holes of a set of wheels, thus saving the cost of new cast steel wheel centers. With the new crank-pins in place the locomotive was fitted with new cylinders and has since been in service for over a year.

Hydraulic power mains aggregating more than 164 miles, are in use in the London district of the London Hydraulic Power Company. Water is distributed from a large station near the Thames under a pressure of 700 lbs. per square inch; the total yearly supply is said to be about 900,000,000 gal. The power is used principally by hydraulic elevators. The number of machines of all classes connected to the power mains increased from 3,240 in 1898 to 6,368 in 1908.

The secretary of a special Spanish commission appointed to consider the extermination of locusts informs Consul Percival Gassett, of Jeres de la Frontera, that about 20 different kinds of sprayers, sprinklers, and burners were tried. A certain one for which a patent has just been applied for was the best. It is made by a tinsmith there and sold at $9, plus packing and freight. A gasoline air-pressure flame is used. A drawing of the mechanism is on file for reference at the Bureau of Manufactures.

The mean height of all land above sea level is estimated at nearly 1,800 ft., the figures for the several continents being as follows: Europe, 975 ft.; Asia, 2,880 ft.; North America, 2,000 ft.; South America, 1,750 ft.; Africa, probably about 2,000 ft. The mean height of the United States, Alaska excluded, is 2,500 ft. Colorado is the highest, averaging 6,800 ft.; Wyoming, second, with 6,700 ft., and Utah third with 6,100 ft. Delaware only averages 60 ft. above sea level. The lowest land in the United States is Death valley, on the southeast border of California, which descends 480 ft. below sea level and is bounded on the east by the Funeral mountains, 7,000 ft., and on the west by the Panimint range, 11,000 ft. high.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

MARCH 1.

950,477. BRAKE-OPERATING MECHANISM. LUKE COURTOIS, Appleton, Wis.

950,495. VACUUM-PRODUCING APPARATUS. LEMUEL W. SERRELL, Plainfield, N. J.

950,531. TRACK-SANDING DEVICE. JOHN GAPP, Scranton, Pa.

950,539. AIR-BRAKE. WILLIAM B. MANN, Baltimore, Md.

950,550. AIR-HEATER FOR AUTOMOBILE TORPEDOES. FRANK M. LEAVITT, New York, N. Y.

950,663. AIR-PIPE COUPLING. WILLIAM J. ELLIS, Andrews, N. C.

950,703. APPARATUS FOR PRODUCING OXIDS OF NITROGEN FROM THE AIR. FRANCIS I. DU PONT, Wilmington, Del.

950,722. PNEUMATIC CLEANING SYSTEM. GEORGE J. KINDEL and ARTHUR W. KINDEL, Denver, Colo.

950,736. COMBINED AUTOMATIC AND STRAIGHT AIR BRAKE. WALTER V. TURNER, Wilmerding, Pa.

950,842. MONOPOLAR VACUUM-TUBE. FRANK A. DAVIS, Boston, Mass.

950,893. JARRING-MACHINE. PHILIP J. CONBOY and JAMES A. MURPHY, Hamilton, Ohio.

3. A jarring machine comprising a column consisting of superposed cylinders of different diameters and formed with an expansion chamber in its upper portion, a counterbored cylinder arranged to slidably engage with the column and formed with a piston and with an annular expansion chamber concentric therewith adapted to slidably engage with the upper portion of the column, passages communicating with said chambers from a source of air under pressure, valves for controlling said passages simultaneously and connections with the counterbored cylinder for operating the valves.

950,945. FLUID-PRESSURE MOTOR AND PUMP. THOMAS MOSS, Portsmouth, and WILLIAM MOSS, Wigan, England.

950,977. MEANS FOR DEODORIZING AND DRYING NIGHT-SOIL AND THE LIKE. EARNEST T. WELCOME, Pittsburg, Pa.

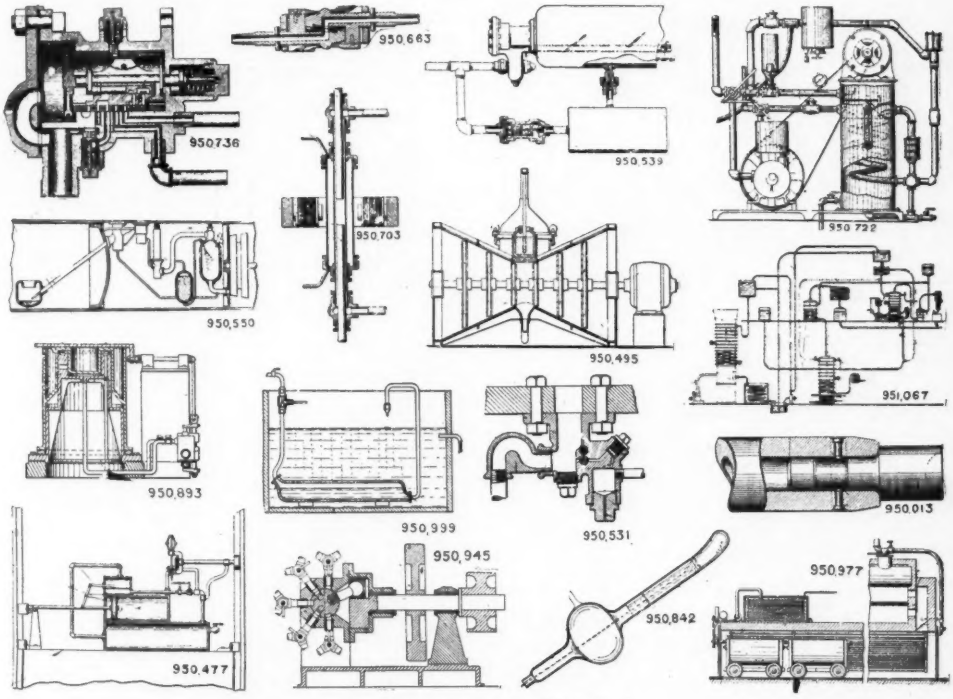
4. Improvements of the character described comprising a furnace, an oven connected with said furnace, several cars in said oven, each of said cars having a chamber or chambers communicating with the car's interior, and means for forcing air through said chambers.

950,999. APPARATUS FOR AERATING WATER. GEORG ERLWEIN, Berlin, and ERNST MARQUARDT, Karow, near Berlin, Germany.

951,013. TOOL-HOLDER FOR PNEUMATIC HAMMERS. VICTOR E. LANE, Berwick, Pa.

951,067. APPARATUS FOR RECOVERING ETHER AND ALCOHOL. CHARLES CREPELLE-FONTAINE, La Madeleine lez Lille, France.

1. An apparatus for recovering ether and alcohol, comprisng an absorption receptacle, means for delivering the *air charged with ether and alcohol* to said receptacle, means for feeding an acid to the upper part of said receptacle, an acid tank, means for carrying the acid saturated with the ether and alcohol from the receptacle to said tank, a recovering apparatus comprising means for separating ether and means for separating alcohol and means for connecting said apparatus with the acid tank.



PNEUMATIC PATENTS, MARCH 1.

MARCH 8.

951,110. APPARATUS FOR RECOVERING ALCOHOL FROM THE LINING OF BARRELS, ETC. JOSEPH J. GILCHRIST, Pittsburg, Pa.

951,154. MONOPLANE AEROPLANE. ROBERT W. STEWART, East Oakland, Cal.

951,162. CENTRIFUGAL APPARATUS FOR COMPRESSING AND PROPELLING FLUIDS. CARLO WEDEKIND, St. Jean-sur-Mer, France.

951,196. AUTOMATIC AIR STEAM CONNECTION. HERKIMER L. MINER, St. Louis, Mo.

951,222. WINDOW-GLASS-DRAWING MACHINE. CHARLES M. RESSLAR, Jeannette, Pa.

1. In a continuous glass drawing machine the combination with an air pipe, a piston carried by said air pipe and means for raising a glass cylinder after the cylinder has been started.

951,465. ROTATION DEVICE FOR FLUID-PRESSURE-OPERATED-HAMMER TOOLS. ALBERT H. TAYLOR, Easton, Pa.

951,513. FLUID-PRESSURE REGULATOR. EDWARD J. ROHRBACHER, Blaine, Wash.

951,529. AIR-PUMP. JUSTIN S. HEMENWAY, River Falls, Wis.

951,559. DRYING APPARATUS. JOHN H. DUNCAN, Ithaca, N. Y.

951,566. PRESSURE-RETAINING DEVICE FOR AIR-BRAKES. JOHN C. HUXHOLD, Chicago, Ill.

951,585. AEROPLANE. HERMAN F. WEIDEL, Rochester, N. Y.

951,615. FLYING-MACHINE. LEO C. KINCANNON, Seabright, Cal.

951,625. AIR-OPERATED FIRE-EXTINGUISHER. PETER L. WILBUR, New York, N. Y.

951,711. VOLUME-RECORDING ATTACHMENT FOR FLUID-METERS. HENRY P. WESTCOTT, Erie, Pa.

1. In a pneumatic track sander, the combination with the base and floor of the sand box, of a sander body beneath the said floor having a sand inlet hole through the said floor and a sand discharge hole through the wall of the base, and an air discharge nozzle within said sander body and opposite to said sand discharge hole.

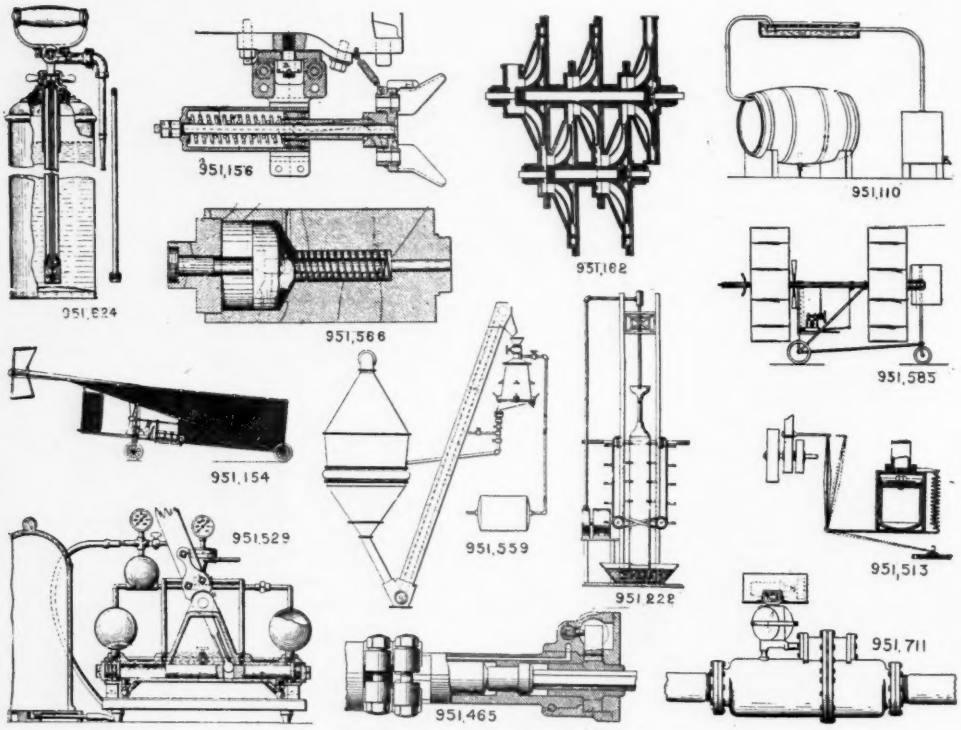
952,121. COCK-CONTROLLING DEVICE FOR AIR-BRAKE SYSTEM. VICTOR J. KOEHLER, Punxsutawney, Pa.

952,244. PORTABLE VACUUM CLEANING DEVICE. JAMES GARDNER, Baltimore, Md.

952,262. PNEUMATIC MUSICAL INSTRUMENT. EUGENE DE KLEIST, North Tonawanda, N. Y.

952,299. AIR-BRAKE. WILLIAM S. BILBREY, West Point, Ga.

952,416. PRESSURE REDUCING AND REGULATING VALVE. JEHU V. CHASE, Newport, R. I.



PNEUMATIC PATENTS, MARCH 8.

MARCH 15.

951,789. OZONE-GENERATOR. FRANK M. ASHLEY, New York, N. Y.

951,822. AIR-VALVE. GEORGE LEICH, New York, N. Y.

951,889. PIPE-COUPLING. WILLIAM H. TENER, Carterville, Mo.

951,899. WINDMILL CONSTRUCTION. EMERSON F. BALDWIN, Philadelphia, Pa.

951,987. DIRECT AIR-BRAKE SYSTEM. ARTHUR DOAN, Oakland, Cal.

952,070. AIR-BRAKE-SYSTEM SIGNALING APPARATUS. SIMON P. COTA, Dickinson, N. D.

952,111. TRACK-SANDER. JOHN H. HANLON, Somerville, Mass.

952,440. AIR-PUMP. CHARLES B. DALZELL, Little Falls, N. Y.

MARCH 22.

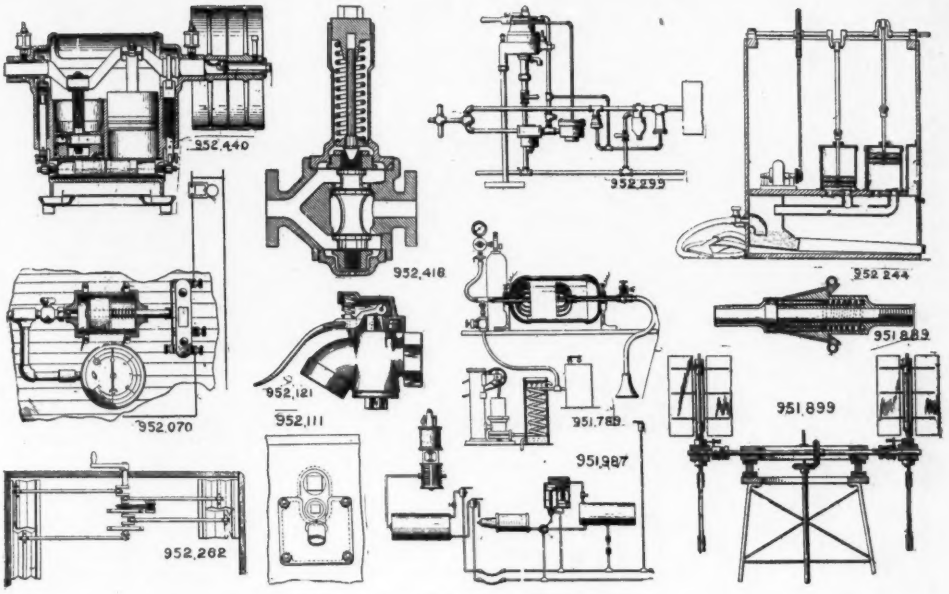
952,452. AUTOMATIC DEPTH-REGULATING DEVICE FOR FREELY-SUBFLOATING BODIES. KARL O. LEON, Gottenberg, Sweden.

952,495. SUCTION SUPPORTING DEVICE. CHARLES A. AUSTIN, New York, N. Y.

952,522. AIR-BLAST DISTRIBUTER. WILLIAM T. HENDRYX, Portland, Oreg.

952,617. PRESSURE-PUMP. FREDERICK W. HUMBARGER, Herrington, and DAVID J. FOREMAN, Kansas City, Kans.

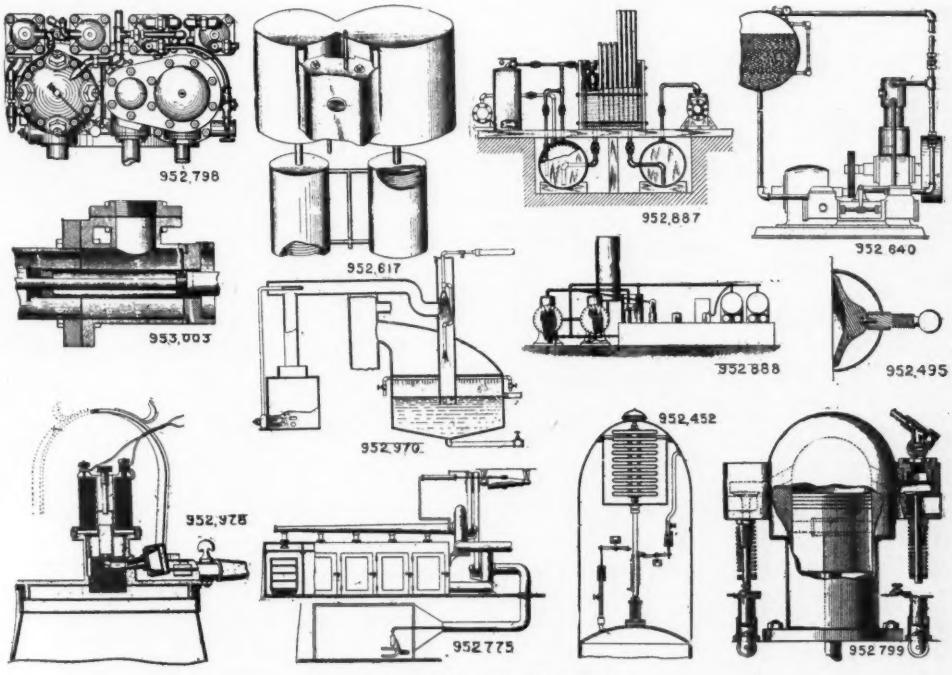
952,640. POWER SET FOR AUTOMATIC SPRINKLERS. EDWARD A. RIX, San Francisco, Cal.



PNEUMATIC PATENTS, MARCH 15.

1. A power set comprising in combination a suitable pump, a suitable air compressor and a pressure tank, air connection between the compresor and tank, connections with both the compressor and the tank by which the pump can be run either from the compressor or from the tank, or both, and water connections between the pumping end of the pump and the tank.

952,707. PNEUMATIC HAMMER. MAX MAXIMILIAN, Buffalo, N. Y.



PNEUMATIC PATENTS, MARCH 22.

952,775. DRIER. MARSHALL WHITLATCH, Montclair, N. J.

1. In a drier, in combination, a chamber, means for causing a flow of air through the chamber under predetermined pressure and exhaust, and automatic means for maintaining the predetermined pressure and exhaust constant.

952,798. AIR-COMPRESSOR. EDSON F. GALLAUDET, Norwich, Conn.

952,799. DEVICE FOR SUPPLYING COMPRESSED AIR. LOUIS GALLI, New York, N. Y.

952,887. WOOD-PRESERVING APPARATUS. PATRICK F. DUNDON, San Francisco, Cal.

2. In an apparatus for treating timber, the combination with a tank, two receivers, pipes leading from the tank into the bottom of the receivers, of a steam boiler and an air pump, pipes connecting the steam boiler with one of the receivers, and pipes conecting the air pump with the top of the other receiver whereby the contents of the receivers may be forced into the tank.

952,888. PROCESS OF CRESOTING WOOD. PATRICK F. DUNDON, San Francisco, Cal.

1. The herein described process of treating wood for preservative purposes, which consists in first extracting the water from the cells by applying steam and radiant heat to the wood in a retort, then applying a vacuum to draw off the water and vapor, then submerging the material under treatment in a preservative liquid, then forcing into the retort an additional quantity of preservative liquid under pressure, then removing the liquid from the retort by means of a gas under pressure, and finally creating a vacuum for removing any surplus liquid.

952,970. FUME-ARRESTER. CLAUDE C. WHITMORE, Butte, Mont.

1. In a fume arresting system, a furnace, an exit flue, an air blast communicating therewith, a water tank, a condensing pipe in communication with said exit flue carried by said water tank and arranged to normally project underneath the water, a spraying device disposed in said condensing pipe, a perforated water pipe arranged in the top of said tank above the surface of the water, settling tanks and an evaporating device connected with said water tank.

952,978. ELECTRIC VACUUM MILKING-MACHINE. GEORGE B. CRAMP, Duquesne, Pa.

952,993. FAN-BLOWER. AUGUST MATHIS, Chicago, Ill.

953,003. HYDROPNEUMATIC PUMP. FREDERICK J. EMENY, Salem, Ohio.

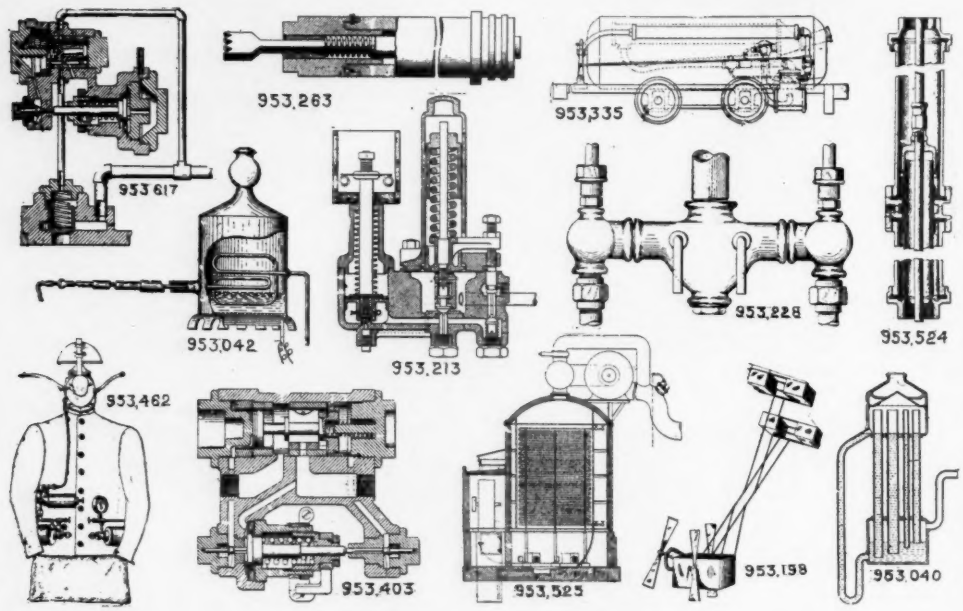
MARCH 29.

953,040. PRESSURE-REGULATOR. HEINRICH KRUGER, Berlin, Germany.

930,042. DENTAL HOT-AIR APPLIANCE. WALTER LAMB, Hanover, Pa.

953,133. VALVE FOR REGULATING THE VOLUME AND PRESSURE OF FLUIDS. ROBERT L. FRINK, Belle Vernon, Pa.

953,198. FLYING-MACHINE. DANIEL C. FUNCHEON, Denver, Colo.



PNEUMATIC PATENTS, MARCH 29.

953,213. FLUID-PRESSURE GOVERNOR. GEORGE MACLOSKIE, Schenectady, N. Y.

953,228. VACUUM AIR-SANDER. CHARLES A. PRATTE, Denver, Colo.

953,263. PNEUMATIC TOOL. JAMES A. GALLAGHER, Midford Station, N. Y.

953,334-5-6. METHOD OF OPERATING COMPOUND COMPRESSED-AIR ENGINES. CHARLES B. HODGES, Pittsburg, Pa.

953,403. FLUID-PRESSURE REGULATOR. WALTER V. TURNER, Wilkinsburg, Pa.

953,462. RESPIRATION APPARATUS FOR USE IN COAL-MINES AND OTHER PLACES. WILLIAM E. GARFORTH, Normanton, England.

953,524. COMBINED AIR AND WATER PUMP. JESSE B. GARBER, Salem, Ohio.

953,525. APPARATUS FOR EXTRACTING MOISTURE FROM AIR FOR BLAST-FURNACES AND CONVERTERS. JAMES GAYLEY, New York, N. Y.

953,617. AUTOMATIC CONTROLLING DEVICE FOR FLUID-COMPRESSORS. HERBERT T. HERR, Denver, Colo.

953,651. ROCK-DRILLING MACHINE. LEE WEST, Ironton, Ohio.

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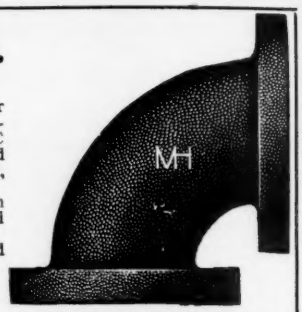

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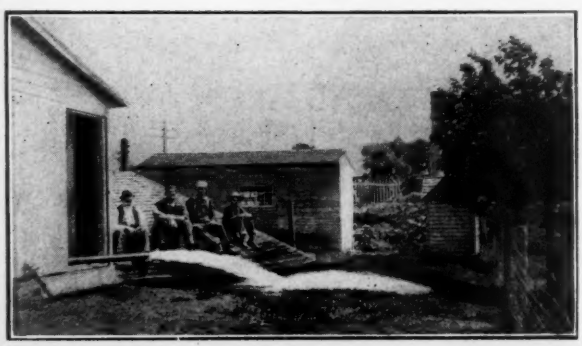

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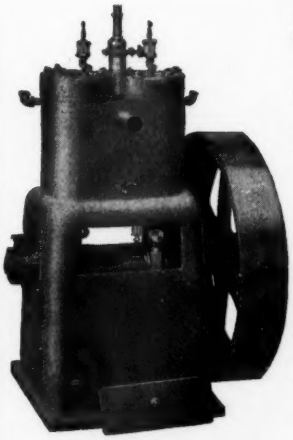

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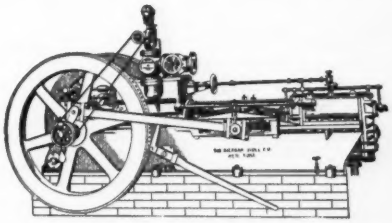

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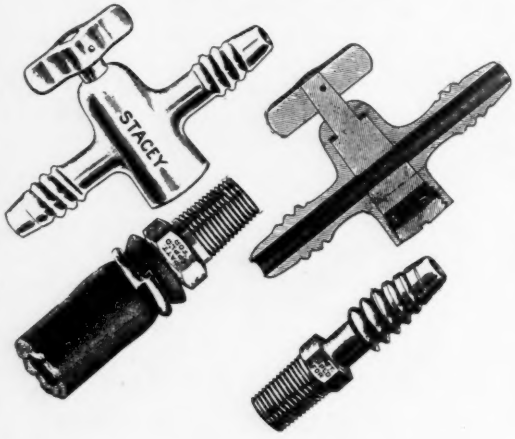

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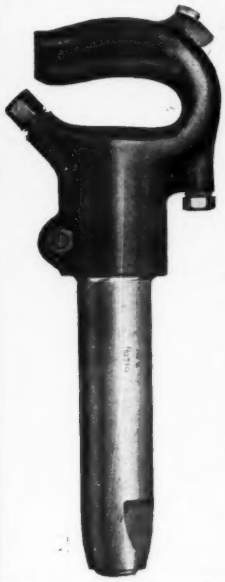

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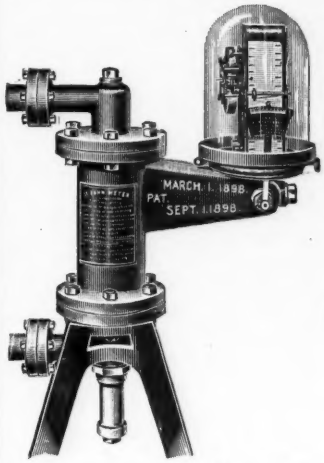

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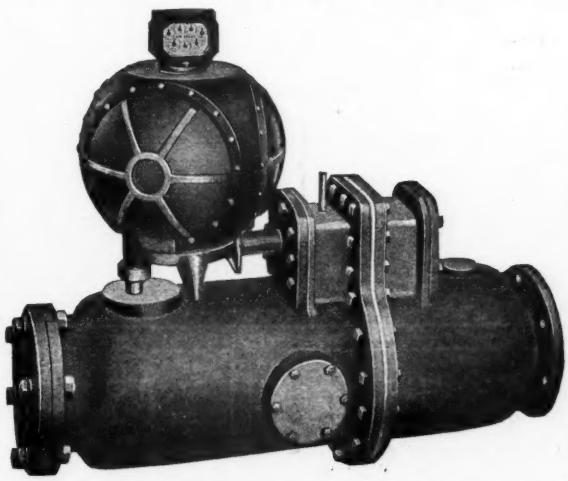

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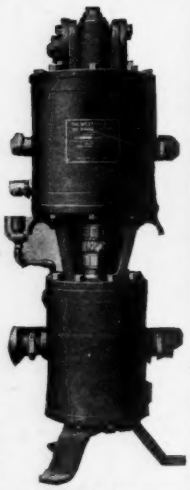

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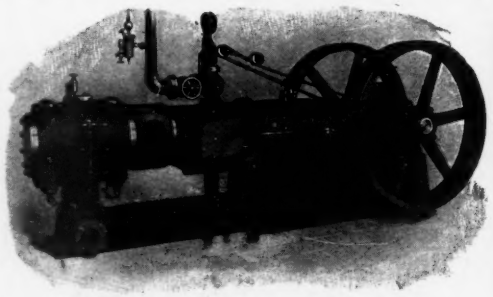

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